Electrical and Electronic Engineering

ACADEMIC SKILLS

AA SPEAKING AND LISTENING

AA1 Utilize effective verbal and non-verbal communication skills
AA2 Participate in conversation, discussion, and group presentations
AA3 Communicate and follow directions/procedures
AA4 Communicate effectively with customers and co-workers

AB READING AND WRITING

AB1 Locate and interpret written information
AB2 Read and interpret workplace documents
AB3 Identify relevant details, facts, and specifications
AB4 Record information accurately and completely
AB5 Demonstrate competence in organizing, writing, and editing using correct vocabulary, spelling, grammar, and punctuation
AB6 Demonstrate the ability to write clearly and concisely using industry specific terminology

AC CRITICAL THINKING AND PROBLEM SOLVING

AC1 Utilize critical-thinking skills to determine best options/outcomes (e.g., analyze reliable/unreliable sources of information, use previous experiences, implement crisis management, develop contingency planning)
AC2 Utilize innovation and problem-solving skills to arrive at the best solution for current situation
AC3 Implement effective decision-making skills

AD MATHEMATICS

AD1 Perform basic and higher level math operations (e.g., addition, subtraction, multiplication, division, decimals, fractions, units of conversion, averaging, percentage, proportion, ratios)
AD2 Solve problems using measurement skills (e.g., distance, weight, area, volume)
AD3 Make reasonable estimates
AD4 Use tables, graphs, diagrams, and charts to obtain or convey information
AD5 Use deductive reasoning and problem-solving in mathematics

AE FINANCIAL LITERACY

AE1 Locate, evaluate, and apply personal financial information
AE2 Identify the components of a budget and how one is created
AE3 Set personal financial goals and develop a plan for achieving them
AE4 Use financial services effectively
AE5 Demonstrate ability to meet financial obligations

AF INTERNET USE AND SECURITY

AF1 Recognize the potential risks associated with Internet use
AF2 Identify and apply Internet security practices (e.g., password security, login, logout, log off, lock computer)
AF3 Practice safe, legal, and responsible use of technology in the workplace

AG INFORMATION TECHNOLOGY

AG1 Use technology appropriately to enhance professional presentations
AG2 Demonstrate effective and appropriate use of social media
AG3 Identify ways social media can be used as marketing, advertising, and data gathering tools

AH TELECOMMUNICATIONS

AH1 Select and use appropriate devices, services, and applications to complete workplace tasks
AH2 Demonstrate appropriate etiquette when using e-communications (e.g., cell phone, e-mail, personal digital assistants, online meetings, conference calls)
EMPLOYABILITY SKILLS

EA POSITIVE WORK ETHIC

EA1 Demonstrate enthusiasm and confidence about work and learning new tasks
EA2 Demonstrate consistent and punctual attendance
EA3 Demonstrate initiative in assuming tasks
EA4 Exhibit dependability in the workplace
EA5 Take and provide direction in the workplace
EA6 Accept responsibility for personal decisions and actions

EB INTEGRITY

EB1 Abide by workplace policies and procedures
EB2 Demonstrate honesty and reliability
EB3 Demonstrate ethical characteristics and behaviors
EB4 Maintain confidentiality and integrity of sensitive company information
EB5 Demonstrate loyalty to the company

EC SELF-REPRESENTATION

EC1 Demonstrate appropriate dress and hygiene in the workplace
EC2 Use language and manners suitable for the workplace
EC3 Demonstrate polite and respectful behavior toward others
EC4 Demonstrate personal accountability in the workplace
EC5 Demonstrate pride in work

ED TIME, TASK, AND RESOURCE MANAGEMENT

ED1 Plan and follow a work schedule
ED2 Work with minimal supervision
ED3 Work within budgetary constraints
ED4 Demonstrate ability to stay on task to produce high quality deliverables on time
EE DIVERSITY AWARENESS

EE1 Recognize diversity, discrimination, harassment, and equity

EE2 Work well with all customers and co-worker

EE3 Explain the benefits of diversity within the workplace

EE4 Explain the importance of respect for feelings, values, and beliefs of others

EE5 Identify strategies to bridge cultural/generational differences and use differing perspectives to increase overall quality of work

EE6 Illustrate techniques for eliminating gender bias and stereotyping in the workplace

EE7 Identify ways tasks can be structured to accommodate the diverse needs of workers

EE8 Recognize the challenges and advantages of a global workforce

EF TEAMWORK

EF1 Recognize the characteristics of a team environment and conventional workplace

EF2 Contribute to the success of the team

EF3 Demonstrate effective team skills and evaluate their importance in the workplace (e.g., setting goals, listening, following directions, questioning, dividing work)

EG CREATIVITY AND RESOURCEFULNESS

EG1 Contribute new ideas

EG2 Stimulate ideas by posing questions

EG3 Value varying ideas and opinions

EG4 Locate and verify information

EH CONFLICT RESOLUTION

EH1 Identify conflict resolution skills to enhance productivity and improve workplace relationships

EH2 Implement conflict resolution strategies and problem-solving skills

EH3 Explain the use of documentation and its role as a component of conflict resolution

EI CUSTOMER/CLIENT SERVICE

EI1 Recognize the importance of and demonstrate how to properly acknowledge customers/clients
EI2 Identify and address needs of customers/clients

EI3 Provide helpful, courteous, and knowledgeable service

EI4 Identify appropriate channels of communication with customers/clients (e.g., phone call, face-to-face, e-mail, website)

EI5 Identify techniques to seek and use customer/client feedback to improve company services

EI6 Recognize the relationship between customer/client satisfaction and company success

EJ ORGANIZATIONS, SYSTEMS, AND CLIMATES

EJ1 Define profit and evaluate the cost of conducting business

EJ2 Identify "big picture" issues in conducting business

EJ3 Identify role in fulfilling the mission of the workplace

EJ4 Identify the rights of workers (e.g., adult and child labor laws and other equal employment opportunity laws)

EJ5 Recognize the chain of command, organizational flow chart system, and hierarchy of management within an organization

EK JOB ACQUISITION AND ADVANCEMENT

EK1 Recognize the importance of maintaining a job and pursuing a career

EK2 Define jobs associated with a specific career path or profession

EK3 Identify and seek various job opportunities (e.g., volunteerism, internships, co-op, part-time/full-time employment)

EK4 Prepare a resume, letter of application, and job application

EK5 Prepare for a job interview (e.g., research company, highlight personal strengths, prepare questions, set-up a mock interview, dress appropriately)

EK6 Participate in a job interview

EK7 Explain the proper procedure for leaving a job

EL LIFELONG LEARNING

EL1 Acquire current and emerging industry-related information

EL2 Demonstrate commitment to learning as a life-long process and recognize learning opportunities

EL3 Seek and capitalize on self-improvement opportunities
EL4 Discuss the importance of flexible career planning and career self-management

EL5 Employ leadership skills to achieve workplace objectives (e.g., personal vision, adaptability, change, shared vision)

EL6 Recognize the importance of job performance evaluation and coaching as it relates to career advancement

EL7 Accept and provide constructive criticism

EL8 Describe the impact of the global economy on jobs and careers

**EM JOB SPECIFIC TECHNOLOGIES**

EM1 Identify the value of new technologies and their impact on driving continuous change and the need for life-long learning

EM2 Research and identify emerging technologies for specific careers

EM3 Select appropriate technological resources to accomplish work

**EN HEALTH AND SAFETY**

EN1 Assume responsibility for safety of self and others

EN2 Follow safety guidelines in the workplace

EN3 Manage personal health and wellness
OCCUPATIONAL SKILLS

OA GENERAL LAB SAFETY RULES AND PROCEDURES

OA1 Describe general shop safety rules and procedures
OA2 Demonstrate knowledge of OSHA and its role in workplace safety
OA3 Comply with the required use of personal protection equipment (PPE) (i.e., safety glasses, ear protection, gloves, shoes) during lab/shop activities
OA4 Utilize safe procedures for handling of tools and equipment
OA5 Operate lab equipment according to safety guidelines
OA6 Identify and use proper lifting procedures and proper use of support equipment
OA7 Utilize proper ventilation procedures for working within the lab/shop area
OA8 Identify marked safety areas and colors
OA9 Identify the location and the types of fire extinguishers and other fire safety equipment, as well as, demonstrating the procedures for usage
OA10 Identify the location and use of eye wash stations
OA11 Identify the location of the posted evacuation routes
OA12 Identify and wear appropriate clothing for lab/shop activities
OA13 Secure hair and jewelry for lab/shop activities
OA14 Demonstrate knowledge of the safety aspects of low and high voltage circuits
OA15 Locate and interpret material safety data sheets (MSDS)
OA16 Perform housekeeping duties
OA17 Follow verbal instructions to complete work assignments
OA18 Follow written instructions to complete work assignments
OA19 Demonstrate ergonomically safe use of lab equipment, furniture and materials

OB HAND TOOLS

OB1 Identify hand tools and their appropriate usage
OB2 Demonstrate the proper techniques when using hand tools
OB3 Demonstrate safe handling and use of appropriate tools

OB4 Demonstrate proper cleaning, storage and maintenance of tools

OC POWER TOOLS AND EQUIPMENT

OC1 Identify power tools/equipment (e.g., band saw, drill press, table saw, sanders, portable power tools) and their appropriate usage

OC2 Demonstrate safe and proper techniques when using power tools and equipment

OC3 Demonstrate proper cleaning, storage and maintenance of power tools and equipment

OC4 Choose correct machining processes(s) based on the given/produced design

OD HISTORY OF STEM

OD1 Define Science, Technology, Engineering and Mathematics (STEM) and their relationship to each other

OD2 Identify engineering & technology achievements (e.g., space race, computer technology, aqueducts, skyscrapers, bridges, subways, airports) throughout history

OD3 Identify famous inventors (e.g., Edison, Tesla, Bell, da Vinci, Washington Carver, Ford) and their achievements throughout history

OD4 Research how historical period and regional style have influenced engineering design

OD5 Investigate the evolution of a product

OD6 Describe the product life cycle

OD7 Describe how your design effects the environment both in a positive and negative way

OE CAREERS IN STEM

OE1 Investigate STEM careers, training, professional organizations and associated opportunities

OE2 Describe the difference between Engineering and Engineering Technology disciplines and job functions

OE3 Explore career opportunities and list the educational requirements for several STEM fields of interest

OE4 Research STEM Fields including non-traditional career paths to understand workload, education, job outlook and salary

OE5 Research STEM education and its role in workforce development

OE6 Identify top KY occupations as they relate to industry sectors
OE7 Utilize KCEWS Future Skills Report to determine future workforce demand in STEM fields

OE8 Research the pros/cons of STEM careers and what their impact is on the Kentucky workforce and on job transitions

OE9 Investigate state and national professional organizations (i.e., KSPE, SAME, NCSEA, SME, NAM, NSPE, ASCE, ABET, SWE, NSBE, LEED, PMP, SHPE) and their importance to fields of engineering

**OF ETHICS IN ENGINEERING**

OF1 Identify current professional engineering codes of ethics

OF2 Analyze ethical engineering issues

OF3 Analyze and explain ethical and technical issues contributing to an engineering disaster

OF4 Describe how ethics influences the engineering process

OF5 Describe the negative impacts technology can have on the environment

OF6 Connect with Engineering and Engineering Technology professionals in your community to discuss engineering ethics

OF7 Identify various standards organizations (i.e., OSHA, EPA, ACS) and their importance in fields of engineering

**OG ENGINEERING DESIGN PROCESS**

OG1 Identify several design processes and evaluate pros/cons of each

OG2 Explain how a design process is a systematic, iterative problem-solving method that produces solutions to meet human needs and wants

OG3 Identify the activities that occur during each phase of a design process

OG4 Specify criteria and identify constraints when defining a problem and determine the most appropriate solution considering time, material, cost and regulations

OG5 Apply the steps of a design process to solve a variety of design problems

OG6 Describe how social, environmental, legal and financial constraints influence a design process

OG7 Utilize conceptual, mathematical and physical models to evaluate design solutions

OG8 Incorporate computer technology to assist in organizing and analyzing data used during a design process

OG9 Document various design process solutions and communicate to the intended audience

OG10 Utilize a cost analysis tool during the design process
OG11 Identify and implement codes and specifications (i.e., AASHTO, IBC, RBC, AISC, ACI, PCI, AISI, NDS, TMS, ASTM, OSHA, ADA, LEED, ASHRE) based on the intended design solution

OG12 Adapt and change as problems arise in the design process

OG13 Demonstrate best practices when working through the design process on a team

OG14 Incorporate ergonomics within each design solution

**OH UTILIZE THE INNOVATION PORTAL**

OH1 Present and justify the problem (Element A)

OH2 Document and analyze prior solution(s) attempt (Element B)

OH3 Present and justify a solution design requirements (Element C)

OH4 Design concept generation, analysis and selection (Element D)

OH5 Apply STEM principles and practices (Element E)

OH6 Consider design viability (Element F)

OH7 Construct of a testable prototype (Element G)

OH8 Develop a prototype testing and data collection plan (Element H)

OH9 Test data collection and analysis (Element I)

OH10 Document external evaluations (Element J)

OH11 Reflect on the design process (Element K)

OH12 Present the designer's recommendations (Element L)

OH13 Present the project portfolio (a holistic grade based on elements A-L) (Element M)

OH14 Write like an engineer (a holistic grade based on elements A-L) (Element N)

**OI FREEHAND TECHNICAL SKETCHING TECHNIQUES**

OI1 Develop design ideas using freehand sketching

OI2 Identify the six primary orthographic views

OI3 Create pictorial and multi-view sketches

OI4 Create rough, refined and presentation sketches

OI5 Utilize the alphabet of lines (i.e., styles and weights)
OI6 Legibly annotate sketches
OI7 Interpret common symbols and terminology

**OJ MEASURING AND SCALING TECHNIQUES**

OJ1 Identify industry standard units of measure
OJ2 Convert between industry standard units of measure
OJ3 Determine and apply the appropriate engineering and metric scales
OJ4 Determine and apply the equivalence between fractions and decimals
OJ5 Demonstrate proper use of precision measuring tools
OJ6 Make precision measurements to the degree of accuracy required by the specifications using appropriate instruments
OJ7 Measure effectively and accurately to accomplish engineering-related tasks
OJ8 Utilize geometric dimensioning and tolerancing to solve engineering problems

**OK ENGINEERING DOCUMENTATION AND COMMUNICATION PROCEDURES**

OK1 Demonstrate record keeping procedures and communication in engineering utilizing an engineering notebook
OK2 Identify the importance of proprietary documentation in engineering
OK3 Utilize project management timelines in a Gantt chart
OK4 Present design solutions in a clear and concise manner
OK5 Demonstrate the conventions of technical writing to communicate design solutions
OK6 Document object size, area, mass, volume and density
OK7 Utilize appropriate digital file management techniques
OK8 Utilize appropriate presentation techniques
OK9 Identify basic components of a computer system and their function
OK10 Use spreadsheet software to analyze and present data
OK11 Communicate project results through a technical report
OK12 Create a portfolio containing all notes, work and projects documenting the course
OK13 Communicate to a non-technical audience your project solution
OL COMPUTER AIDED DESIGN (CAD) SYSTEM

OL1 Identify various 2D and 3D CAD software

OL2 Interpret basic elements of a technical drawing (i.e., title block information, dimensions, line types)

OL3 Describe and construct various types of CAD drawings (i.e., part, assembly, drawing files)

OL4 Construct drawings utilizing metric and customary (i.e., SAE and Imperial) measurement systems

OL5 Arrange dimensions and annotations using appropriate standards (i.e., ANSI and ISO)

OL6 Read technical drawings identifying and understand the dimensional tolerances and limits

OL7 Construct exploded assembly drawings with part lists and balloons

OL8 Create rendered drawings

OL9 Utilize a CAD modeling system to perform a physical property analysis (i.e., quantities, take offs, area, mass, weight) for a part or assembly

OL10 Calculate costs and physical requirements impacted by product physical properties of a product

OL11 Use appropriate technology (i.e., camera, video) to allow a walkthrough of a project

OM MODELING TECHNIQUES

OM1 Identify the areas of modeling (i.e., physical, conceptual, mathematical)

OM2 Create various mock-ups, scale models and working prototypes based on CAD drawings

OM3 Evaluate various mock-ups, scale models and working prototypes using a design process

OM4 Design simulations to model intended design outcomes

OM5 Create virtual walk throughs and fly overs to model intended design outcomes

OM6 Describe the difference between additive and subtractive modeling

ON RAPID PROTOTYPING TECHNOLOGY

ON1 Explain how technology shifts throughout history have made rapid prototyping possible

ON2 Explain current and emerging rapid prototyping applications in a variety of industries

ON3 Describe the advantages and limitations of each rapid prototyping technology

ON4 Evaluate real-life scenarios and recommend the appropriate use of rapid prototyping technology

ON5 Identify opportunities to apply rapid prototyping technology for time and cost savings
ON6 Discuss the economic implications of rapid prototyping including its impact on startup businesses and supply chains

ON7 Determine appropriate rapid prototyping process to solve various design problems

ON8 Determine appropriate rapid prototyping material(s) to solve various engineering related problems

ON9 Demonstrate an understanding of rapid prototyping using a 3D printer to solve engineering related problems

ON10 Demonstrate an understanding of rapid prototyping using a laser engraver to solve engineering related problems

ON11 Demonstrate an understanding of rapid prototyping using a CNC equipment to solve engineering related problems

ON12 Demonstrate an understanding of rapid prototyping using breadboards and microcontrollers to solve engineering related problems

OO ARCHITECTURE AND BUILDING CONSTRUCTION

OO1 Identify various building, fire, ADA and safety codes

OO2 Apply various building, fire, ADA and safety codes

OP BUILDING INFORMATION MODELING (BIM) & CITY INFORMATIONAL MODELING (CIM)

OP1 Interpret HVAC, electrical, plumbing and mechanical systems construction documents

OP2 Create HVAC, electrical plumbing and mechanical systems construction documents

OQ ELECTRICAL & ELECTRONICS ENGINEERING

OQ1 Define electrical and electronics engineering

OQ2 Research careers related to electrical and electronics engineering and their education requirements

OR BASIC ELECTRICITY

OR1 Measure circuit values (e.g., voltage, resistance, current) using a digital multimeter

OR2 Construct and calculate voltage, resistance and current of series and parallel circuits using Ohm’s law

OR3 Demonstrate breadboarding through various projects

OR4 Demonstrate basic programming skills related to electronics

OR5 Interpret basic electrical schematics
OR6 Compare and contrast the behavior of electrical circuits with parallel and series circuit designs

OR7 Demonstrate soldering through various projects

OR8 Determine resistor values based on color code

OR9 Determine capacitor values based on capacitor codes

OR10 Understand the basic function of switches (e.g., SPST, DPDT, push button, dip, rotary)

OR11 Demonstrate proper use of circuit design software (CDS) in making schematics and in simulations

OS INTERMEDIATE CIRCUITS AND LAWS OF ELECTRICITY

OS1 Calculate capacitance of circuits with capacitors wired in series and parallel

OS2 Construct, calculate and measure the electrical power utilized in a resistive circuit using Watt’s law

OS3 Utilize Kirchhoff’s Laws (KVL) and (KCL) to analyze resistive circuits

OS4 Demonstrate proper use of various electrical equipment used to measure electrical properties (e.g., digital multimeter, analog voltage, current meters, oscilloscope and capacitance meters)

OS5 Understand the basic function of a diode/LED in a circuit

OS6 Understand the advantage and disadvantages of AC and DC electrical systems and their applications

OS7 Design, build and measure simple R-C circuits

OT SIGNALS AND TIMERS

OT1 Demonstrate proper use of an oscilloscope to measure the charge time and discharge time of an R-C Circuit

OT2 Understand the differences of analog and digital signals

OT3 Understand and measure (i.e., oscilloscope) the basic properties of waveforms (e.g., frequency, wavelength, period and duty-cycle)

OT4 Design various timer circuits using the 555-timer diagram and appropriate formulas

OU DIGITAL CIRCUIT DESIGN

OU1 Design, create and interpret electrical schematics that include various electrical components used in digital circuit design

OU2 Interpret integrated circuit data sheets

OU3 Describe the differences between TTL and CMOS integrated circuits
OU4 Understand the advantages and disadvantages of integrated circuit packages (e.g., small scale (SSI), medium scale (MSI), large scale (LSI) and very large scale (VLSI))

OU5 Create and interpret logic truth tables

OU6 Understand the truth tables of the basic And, Or, Inverter (AOI) logic gates and to create logic expressions

OU7 Utilize truth tables to design, simulate and construct AOI circuits

OU8 Utilize Boolean algebra and DeMorgan’s theorems to simplify logic expressions

OU9 Understand the differences between Sum of Products (SOP) and Product of Sums (POS) Boolean expressions

OU10 Analyze circuit schematics to determine circuit function and to troubleshoot circuits that are not functioning properly

OU11 Design, create and interpret digital circuits using universal gates (i.e., NAND, NOR)

OU12 Utilize Karnaugh maps (K-maps) to simplify truth tables and logic expressions

OU13 Understand how to use the don't care condition in K-maps

OU14 Label and utilize seven segment displays in digital circuits

OU15 Utilize multiplexers, demultiplexers, encoders and decoders appropriately in digital circuits to drive displays and conserve power usage

OV ADDERS

OV1 Understand and be able to convert between number systems (i.e., Base 10, Base 2, Base 8 and Base 16)

OV2 Utilize two’s complement arithmetic to represent negative numbers and to add numbers in binary

OV3 Understand the truth table and function of the exclusive or (XOR) and exclusive nor (XNOR) gates

OV4 Utilize one half adder and full adders to create binary adder digital circuits

OW LATCHES AND FLIP-FLOP CIRCUITS

OW1 Understand how flip-flops (D and JK) are utilized in computer memory

OW2 Design event detection circuits with latches

OW3 Understand the difference in the operation of sequential circuits that operate on the rising or falling edge of clock signals

OX COUNTER CIRCUITS
OX1 Design, create and implement up, down and modulus synchronous (parallel) counters

OX2 Design, create and implement up, down and modulus asynchronous (ripple) counters

OX3 Analyze timing diagrams of various sequential circuits using the oscilloscope

**OY PLD’S, STATE MACHINES AND MICROCONTROLLERS**

OY1 Design, create and implement Programmable Logic Devices (PLD) in digital circuits

OY2 Design state machines using state graphs and transition tables

OY3 Design, create and implement state machines that move through various states based on a clock and various input sensors (e.g., switches, photoelectric, infrared) and each state will drive a specific set of outputs (e.g., motors, servos, LED’s, displays)

OY4 Design, create and implement various advanced digital circuits (e.g., counters, timers, state machines) with a microcontroller

**OZ MANUFACTURING SYSTEMS**

OZ1 Describe how input and output devices are part of an open and closed loop system

OZ2 Relate sensor inputs to the environment being measured

OZ3 Operate output devices to perform a function

**OAA ROBOTIC ENGINEERING**

OAA1 Identify various inputs and output used in robotic systems

**OAB DRIVE TRAIN AND STRUCTURE**

OAB1 Understand basic electrical and magnetic properties and their application to various types of electric motors and servos

**OAC ROBOTIC SUB-SYSTEMS**

OAC1 Distinguish between digital and analog components

OAC2 Describe the operation and use of various forms of electrical motors in robotic assemblies