

## **MECHATRONICS 3**

### **COURSE CODE: 6212**

**COURSE DESCRIPTION:** Mechatronics is an interdisciplinary field involving electrical, mechanical, instrumentation, electronics, robotics/automation, computer components, and control systems. The intent of the program is to prepare students with entry-level industrial skills for the workforce or to prepare them for entry into post-secondary programs.

The focus of Mechatronics 3 includes motor controls and starters, hydraulics, electrical test equipment, and professional development.

**NCCER CONNECT** embedded within the program of study is an (optional) component utilized at the discretion of the district.

**OBJECTIVE:** Given the necessary equipment, materials, and instruction, the student, on completion of the prescribed course of study, will be able to successfully accomplish the following standards.

**RECOMMENDED GRADE LEVELS:** 11 - 12

**CREDIT:** 1 unit (120 hours), 2 units (240 hours) per activity code

**PREREQUISITE:** None

**RESOURCES:** [Instructional Materials](#)

#### **A. SAFETY**

**Proficient professionals know the academic subject matter, including safety as required for proficiency within their area. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in any program of study.**

1. Review school safety policies and procedures.
2. Review classroom safety rules and procedures.
3. Review safety procedures for using equipment in the classroom.
4. Identify major causes of work-related accidents in office environments.
5. Demonstrate safety skills in an office/work environment.

#### **B. STUDENT ORGANIZATIONS**

**Proficient professionals know the academic subject matter, including professional development, required for proficiency within their area. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in any program of study.**

1. Identify the purpose and goals of a Career and Technology Student Organization (CTSO).
2. Explain how CTSOs are integral parts of specific clusters, majors, and/or courses.
3. Explain the benefits and responsibilities of being a member of a CTSO.
4. List leadership opportunities that are available to students through participation in CTSO conferences, competitions, community service, philanthropy, and other activities.
5. Explain how participation in CTSOs can promote lifelong benefits in other professional and civic organizations.

### **C. TECHNOLOGY KNOWLEDGE**

**Proficient professionals know the academic subject matter, including the ethical use of technology as needed in their role. The following accountability criteria are considered essential for students in any program of study.**

1. Demonstrate proficiency and skills associated with the use of technologies that are common to a specific occupation.
2. Identify proper netiquette when using e-mail, social media, and other technologies for communication purposes.
3. Identify potential abuse and unethical uses of laptops, tablets, computers, and/or networks.
4. Explain the consequences of social, illegal, and unethical uses of technology (e.g., piracy; illegal downloading; cyberbullying; licensing infringement; inappropriate uses of software, hardware, and mobile devices in the work environment).
5. Discuss legal issues and the terms of use related to copyright laws, Creative Commons, fair use laws, and ethics pertaining to downloading of images, photographs, Creative Commons, documents, video, sounds, music, trademarks, and other elements for personal use.
6. Describe ethical and legal practices of safeguarding the confidentiality of business-related information.
7. Describe possible threats to a laptop, tablet, computer, and/or network and methods of avoiding attacks.

### **D. PERSONAL QUALITIES AND EMPLOYABILITY SKILLS**

**Proficient professionals know the academic subject matter, including positive work practices and interpersonal skills, as needed in their role. The following accountability criteria are considered essential for students in any program of study.**

1. Demonstrate creativity and innovation.
2. Demonstrate critical thinking and problem-solving skills.
3. Demonstrate initiative and self-direction.
4. Demonstrate integrity.
5. Demonstrate work ethic.
6. Demonstrate conflict resolution skills.
7. Demonstrate listening and speaking skills.
8. Demonstrate respect for diversity.
9. Demonstrate customer service orientation.

10. Demonstrate teamwork.

## **E. PROFESSIONAL KNOWLEDGE**

**Proficient professionals know the academic subject matter, including positive work practices and interpersonal skills, as needed in their role. The following accountability criteria are considered essential for students in any program of study.**

1. Demonstrate global or “big picture” thinking.
2. Demonstrate career and life management skills and goal-making.
3. Demonstrate continuous learning and adaptability skills to changing job requirements.
4. Demonstrate time and resource management skills.
5. Demonstrates information literacy skills.
6. Demonstrates information security skills.
7. Demonstrates information technology skills.
8. Demonstrates knowledge and use of job-specific tools and technologies.
9. Demonstrate job-specific mathematics skills.
10. Demonstrates professionalism in the workplace.
11. Demonstrates reading and writing skills.
12. Demonstrates workplace safety.

**Mechatronics 3 is the minimum standards for articulation of Mechatronics to (some) technical colleges in South Carolina.**

## **F. MOTOR CONTROLS AND STARTERS**

**Mechatronics professionals demonstrate appropriate knowledge and usage of motor controls and starters as needed in their role. The following accountability criteria are considered essential for students in the Mechatronics program of study.**

1. Define the following terms:
  - a) Ampacity
  - b) Branch circuit
  - c) Circuit breaker
  - d) Controller
  - e) Duty
  - f) Equipment
  - g) Full-load amps
  - h) Ground fault circuit interrupter
  - i) Interrupting rating
  - j) Motor circuit switch
  - k) Thermal protector
  - l) NEMA design letter
  - m) Non-Automatic
  - n) Overcurrent
  - o) Overload

- p) Power factor
  - q) Rated full-load speed
  - r) Rated horsepower
  - s) Service factor
  - t) Thermal cutout
  - u) Remote control circuit
2. Describe the various types of motor enclosures.
  3. Describe how the rated voltage of a motor differs from the system voltage.
  4. Describe the basic construction and components of a three-phase squirrel cage induction motor.
  5. Explain the relationships among speed, frequency, and the number of poles in a three-phase induction motor.
  6. Describe how torque is developed in an induction motor.
  7. Explain how and why torque varies with rotor reactance and slip.
  8. Define percent slip and speed regulation.
  9. Explain how the direction of a three-phase motor is reversed.
  10. Describe the component parts and operating characteristics of a three-phase wound rotor induction motor.
  11. Describe the component parts and operating characteristics of a three-phase synchronous motor.
  12. Define torque, starting current, and armature reaction as they apply to DC motors.
  13. Explain how the direction of rotation of a DC motor is changed.
  14. Describe the design and characteristics of a DC shunt, series, and compound motor.
  15. Describe dual-voltage motors and their applications.
  16. Describe the methods for determining various motor connections.
  17. Describe general motor protection requirements as delineated in the National Electrical Code (NEC).

## **G. HYDRAULICS (OPTIONAL PER DISTRICT ADVISORY RECOMMENDATION)**

**Mechatronics professionals demonstrate appropriate usage of electro pneumatics and hydraulics as needed in their role. The following accountability criteria are considered essential for students in the Mechatronics program of study.**

1. Demonstrate hydraulic system safety.
2. Explain the principles of hydraulics and hydraulic fluids.
3. Demonstrate the ability to read, construct, and interpret hydraulic fluid power symbols as well as fluid power diagrams.
4. Identify the various configurations of hydraulic directional control valves (DCV).
5. Explain hydraulic systems (forces, speed, friction, flow, and pressure).
6. Identify types of hydraulic pumps, motors, and actuators.
7. Construct hydraulic systems from component and schematic symbols.
8. Demonstrate correct installation and maintenance as well as preventive maintenance techniques for hydraulic fluid power systems using schematic

diagrams.

9. Troubleshoot and repair hydraulic fluid power systems using schematic diagrams.

## **H. ELECTRICAL TEST EQUIPMENT**

**Mechatronics professionals demonstrate appropriate knowledge and usage of electrical test equipment as needed in their role. The following accountability criteria are considered essential for students in the Mechatronics program of study.**

1. Demonstrate the operation of the following pieces of test equipment:
  - a) Clamp-On Ammeter
  - b) Multimeter
  - c) Frequency meter
  - d) Oscilloscope (Optional)
  - e) Voltage tester
  - f) Megger (Optional)
2. Represent results using engineering notation.
3. Demonstrate the importance of proper meter polarity.
4. Demonstrate frequency using a frequency meter.
5. Compare the difference between digital and analog meters.

## **I. PROFESSIONAL DEVELOPMENT**

**Mechatronics professionals demonstrate appropriate career-readiness skills. The following accountability criteria are considered essential for students in the Mechatronics program of study.**

1. Examine the extent of career opportunities in manufacturing and the education required for entry level employment.
2. Identify available resources to find a specific manufacturing career and/or job
3. Recommend a program designed to develop technical skills and knowledge needed in a chosen manufacturing field and identify the strengths of the program.
4. Build an inventory of work attitudes, personality traits, and professional characteristics needed for a successful career in Mechatronics.
5. Produce a resume and cover letter demonstrating the education qualifications and/or experience level necessary for a chosen engineering major or career opportunity.
6. Develop a personal written or digital portfolio showcasing professional writing samples, creative designs, research materials and notable accomplishments.
7. Produce a research document that examines the ethics, fundamental practices, and professional obligations required to exhibit high standards of integrity in the field of Mechatronics.

Additional Resources and Materials

Course Academic Standards and Indicators