

MECHATRONICS 4
COURSE CODE: 6213

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.

Mechatronics 4 focuses on advanced levels of mechatronic skills, such as PLCs robotics, mechanical drive systems and A/C circuits. Students are may have the opportunity to participate in school-to-work opportunities such as apprenticeship or internship. When in the classroom, students work independently or collaboratively on specialized projects integrating career-ready skills in preparation for entering the workforce or post-secondary institution.

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 4 is the minimum standards for articulation of Mechatronics to (some) technical colleges in South Carolina. The following may be required for dual credit and may be addressed if extra time allows.

F. MECHANICAL DRIVE SYSTEMS

Mechatronics professionals demonstrate appropriate knowledge and skills for usage of mechanical drive systems as needed in their role. The following accountability criteria are considered essential for students in the Mechatronics program of study.

1. Identify and demonstrate the basic principle of Mechanical Systems.
2. Identify components of mechanical drive systems, including motors, shafts, gear boxes, bearings, etc.
3. Setup and demonstrate drive systems using bearings, belts, couplings, pulleys, gears, sprockets, chain drives, u-joints, etc.
4. Identify the different types of lubrication used in mechanical drive systems.
5. Demonstrate use of a deflection gauge for belt tensioning.
6. Demonstrate the use of various alignment tools, e.g., shaft, laser, and dial indicators.
7. Identify the basic structure of clutches and brakes.
8. Identify component structure and principles of seals, gaskets, and

packing.

G. A/C CIRCUITS DIGITAL FUNDAMENTALS (OPTIONAL)

Mechatronic professionals demonstrate knowledge in digital A/C circuits as needed in their role. The following accountability criteria are considered essential for students in the Mechatronics program of study.

1. Calculate the peak and effective voltage or current values for an AC waveform.
2. Calculate the phase relationship between two AC waveforms.
3. Measure the voltage and current phase relationship in a resistive AC circuit.
4. Describe the voltage and current transients that occur in an inductive circuit.
5. Define inductive reactance.
6. Describe the voltage and current transients that occur in a capacitive circuit.
7. Define capacitive reactance.
8. Construct circuits showing the relationship between voltage and current in the following types of AC circuits:
 - a) Resistive Inductive (RL) circuit
 - b) Resistive Capacitive (LC) circuit
8. Describe the effect that resonant frequency has on impedance and current flow in a series or parallel resonant circuit.
9. Describe how bandwidth is affected by resistance in a series or parallel resonant circuit.
10. Describe the following terms as they relate to AC circuits:
 - a) True power
 - b) Reactive power
 - c) Apparent power
 - d) Power factor
11. Describe the operation of a transformer.

H. ADVANCED PROGRAMMABLE LOGIC CONTROLLERS (PLC) (OPTIONAL)

Mechatronic professionals demonstrate advanced knowledge and usage of programmable logic controllers as needed in their role. The following accountability criteria are considered essential for students in the Mechatronics program of study.

1. Hardwire PLC systems.
2. Apply the numbering systems, e.g., binary, hexadecimal, base 10, in a PLC project.
3. Integrate Boolean logic.
4. Use the proper power supply within a PLC system.
5. Construct input/output (I/O) circuits.
6. Use analog, digital, and input/output components within a PLC system.

7. Use timers, logic gates, and relay logic to perform a task within a PLC system.
8. Diagram a PLC process using a flow chart.
9. Troubleshoot problems in a PLC circuit using a given diagram.

I. INTRODUCTION TO ROBOTICS SYSTEMS (OPTIONAL)

Mechatronic professionals demonstrate appropriate knowledge and usage of robotics systems as needed in their role. The following accountability criteria are considered essential for students in the Mechatronics program of study.

1. Explain basic safety of robotics systems.
2. Explain OSHA requirements for robotics systems.
3. Construct a process application for robotics systems.
4. Describe the different types of robots.
5. Identify the different parts of a robot and their functions.
6. Demonstrate the ability to service, maintain, and troubleshoot a simple robot.
7. Demonstrate robotic coordinate systems.

J. PROFESSIONAL DEVELOPMENT

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

1. Utilize work-based/workplace learning experiences to demonstrate and expand upon knowledge and skills gained during classroom instruction and laboratory practices.
2. Demonstrate proficiency in a career area that leads to certification, licensure, and/or continued learning at the postsecondary level, i.e. dual credit enrollment, CAD certification, etc.
3. Enhance the portfolio, or similar collection of work, that offers evidence of knowledge competency, as well as a current resume' and other employability documents.

K. OPTIONAL SPECIALIZATIONS OR CAPSTONE

Mechatronics professionals demonstrate and apply the knowledge and skills contained in the Mechatronics standards and indicators in classroom, laboratory, and workplace settings.

1. Brainstorm, design and construct a culminating real world project effectively in a capstone course.
 - a. Use methods and techniques for employing all manufacturing equipment appropriately.
 - b. Apply conventional manufacturing processes and procedures accurately, appropriately, and safely.
 - c. Apply the concepts of mechatronics to the tools, equipment, projects, and procedures.
 - d. Apply science and mathematics to provide results, answers, and algorithms for manufacturing and technological activities.

- e. Apply manufacturing concepts to the development of plans, processes and projects that address real world problems.
 - f. Collect and analyze results from project-based activities and communicate with various stakeholders.
 - g. Apply the knowledge learned in the study of Manufacturing to provide solutions to human and societal problems in an ethical and legal manner.
2. Demonstrate entrepreneurship skills and knowledge of self-employment options and innovative ventures (e.g., cost analysis, market research, packaging, etc.)

Additional Materials and Resources

Course Academic Standards and Indicators