CORE ENGINEERING 2
COURSE CODE: 6371

COURSE DESCRIPTION: Core Engineering 2 is the second course in the Core Engineering program. This course is designed to expose students to various fields in engineering such as materials science, kinematics, electronics and circuits, thermodynamics, manufacturing, and control systems. Engineering design and process concepts are expanded and used in the course. A general knowledge of engineering and a number of design projects emphasizing teamwork, problem solving, and decision making in engineering design will be incorporated throughout the course. Students will be required to create and present designs using 3D CAD software.

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

RECOMMENDED GRADE LEVELS: 9-10

COURSE CREDIT: 1 (120 hours)

PREREQUISITE: Core Engineering 1 completed with grade C (70%) or higher and completion of Algebra 1 or Equivalent

COMPUTER REQUIRED: 1 Computer per student with Internet access

RECOMMENDED SOFTWARE: CAD program (See Resource List)

RECOMMENDED MAXIMUM ENROLLMENT: 24

RESOURCES: S.C. 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 positions. 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.

F. SIMPLE MACHINES AND MECHANISMS

Engineering professionals demonstrate appropriate knowledge and use of simple machines and mechanisms as needed in their role. The following accountability criteria are considered essential for students in the Core Engineering program of study.

1. Identify the six types of simple machines and their parts.
2. Calculate work and power.

3. Calculate ideal mechanical advantage.
4. Calculate actual mechanical advantage.
5. Calculate mechanical system efficiency.
6. Calculate variables of gear-driven systems such as angular velocity, torque, gear ratios, number of teeth, and direction of rotation.
7. Calculate variables of belts-driven systems such as angular velocity, diameters, and torque.
8. Design, build, and evaluate a compound machine.

G. STATICS AND STRUCTURAL ANALYSIS

Engineering professionals demonstrate appropriate knowledge and use of statics and structural analysis as needed in their role. The following accountability-criteria are considered essential for students in the Core Engineering program of study.

1. Identify and apply Newton's Three Laws of Motion.
2. Calculate the centroid of simple shape.
3. Calculate the centroid of a complex shape.
4. Calculate the moment of inertia for a rectangular shape.
5. Calculate beam deflection.
6. Calculate modulus of elasticity.
7. Understand vector notation.
8. Analyze a vector and calculate component forces.
9. Create a free body diagram for a system.
10. Calculate moments about an axis.
11. Calculate reaction forces for a structure.
12. Calculate tensile and compressive forces in a truss.
13. Calculate strength to weight ratio.
14. Design, build, test, and analyze a simple truss.

H. ELECTRONICS AND CIRCUITS

Engineering professionals demonstrate appropriate knowledge and skills in electronics and circuits as needed in their role. The following accountability-criteria are considered essential for students in the Core Engineering program of study.

1. Identify electrical hazards.
2. Understand and demonstrate safety procedures.
3. Calculate work and power.
4. Explain and classify a material as either a conductor or insulator.
5. Identify and measure electrical components in a circuit.
6. Distinguish between conventional current and electron current flow.
7. Distinguish between AC and DC current.
8. Distinguish between analog and digital.

9. Define Ohms law.
10. Define Kirchhoff's current and voltage laws.
11. Explain the relationship between voltage, current, and resistance.
12. Calculate electrical properties using Ohm's law and Kirchhoff's laws.
13. Identify, create, and analyze series, parallel, and simple combination circuits.

I. MACHINE DESIGN AND CONTROL SYSTEMS

Engineering professionals demonstrate appropriate knowledge and skills in machine design and control systems as needed in their role. The following accountability-criteria are considered essential for students in the Core Engineering program of study.

1. Differentiate between open and closed loop systems.
2. Identify and select appropriate inputs, outputs, and sensors.
3. Design, build, program, and test an automated system/robot to perform a task.

J. MATERIALS SCIENCE

Engineering professionals demonstrate appropriate knowledge and use of material science as needed in their role. The following accountability-criteria are considered essential for students in the Core Engineering program of study.

1. Demonstrate knowledge of classes of materials and their properties.
2. Justify material choices for a product in terms of availability, cost, manufacturing methods, application, and environment.
3. Identify and choose appropriate processes for manufacturing, such as casting, milling, turning, forming, and grinding (additive versus subtractive processes).
4. Explain how raw materials are transformed into finished products including the product life cycle (disposal, recycling, and environmental impacts).
5. Calculate stress and strain.
6. Evaluate properties of a metal from a stress/strain curve.
7. Perform a destructive test on a metal (physically or virtually).

K. KINEMATICS

Engineering professionals demonstrate appropriate knowledge and use of kinematics as needed in their role. The following accountability-criteria are considered essential for students in the Core Engineering program of study.

1. Identify forces acting upon a projectile.
2. Calculate firing angle, initial velocity, and range.
3. Understand concepts of position, velocity, and acceleration.
4. Design, build, test, and evaluate a ballistic device.

L. THERMODYNAMICS (OPTIONAL)

Engineering professionals demonstrate appropriate knowledge and use of thermodynamics as needed in their role. The following accountability-criteria are considered essential for students in the Core Engineering program of study.

1. Identify and explain the three methods of heat transfer (conduction, convection, and radiation).
2. Calculate rate and amount of heat transfer in thermodynamic systems.
3. Analyze a structure for heat transfer using R-values.
4. Identify and explain the laws of thermodynamics.
5. Design, build, test, and analyze a simple thermodynamic system for heat loss.

M. FLUID DYNAMICS (OPTIONAL)

Engineering professionals demonstrate appropriate knowledge and use of fluid dynamics as needed in their role. The following accountability-criteria are considered essential for students in the Core Engineering program of study.

1. Identify the types and applications of fluid power systems.
2. Calculate work and power.
3. Compare pneumatic versus hydraulic systems.
4. Calculate properties of a fluid power system using Pascal's Law.
5. Calculate temperature, pressure, and volume using ideal gas laws.
6. Design, build, test, and analyze a fluid power system.

Academic Standards and Indicators

Additional Course Materials and Resources