MECHANICAL DESIGN 1 AND 2
Course Codes: 6172, 6173

COURSE DESCRIPTION: The Mechanical Engineering program prepares students interested in Mechanical Engineering Design professions through design technology and techniques. Using computer-aided software, students create assembly drawings that meet industry standards and codes. Upon successful completion of the Mechanical Engineering program, students will be prepared for postsecondary education and entry-level mechanical engineering-related careers.

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 core competencies.

RECOMMENDED GRADE LEVELS: 9 - 12

CREDIT:	1 (120 hours) or 2 (240 hours) Carnegie units per course code
RECOMMENDED PREREQUISITE:	None
COMPUTER REQUIREMENT:	One computer per student
RECOMMENDED SOFTWARE:	AutoDesk Suite or Solidworks, most current version
RESOURCES:	SC Instructional Materials and Resources

SAFETY

Proficient professionals know the academic subject matter, including safety as required for proficiency within their area. 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.

STUDENT ORGANIZATIONS

Proficient professionals know the academic subject matter, including professional development. 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.

TECHNOLOGY KNOWLEDGE

Proficient professionals know the academic subject matter, including the ethical use of technology. 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.

PERSONAL QUALITIES AND EMPLOYABILITY SKILLS

Proficient professionals know the academic subject matter, including positive work practices and interpersonal skills. 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.

PROFESSIONAL KNOWLEDGE

Proficient professionals know the academic subject matter, including positive work practices and interpersonal skills. 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.

A. INTRODUCTION TO DRAFTING TECHNIQUES

Proficient drafters demonstrate appropriate drafting skills. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Identify alphabet of lines to include line weight (thickness).
2. Create orthographic drawings.
3. Utilize hand lettering techniques to neatly add notes and/or dimensions to sketches.
4. Demonstrate measuring skills using various tools, including various scales.

B. DEMONSTRATE CAD-SPECIFIC SKILLS

Proficient drafters demonstrate appropriate 2D and 3D CAD-specific skills, as needed in their role. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Identify and utilize elements of the graphical user interface (e.g., ribbon, panels, command line, drop-down menus, and toolbars.
2. Identify the use of various file formats (e.g., .dwg, .bak, .stl, .ipt, .sldprt).
3. Import and export various data files between formats.
4. Open and save various file types in a structured directory.

5. Perform drawing setup to applicable standards (e.g., setting layers, line type, and line weight).
6. Identify and use display commands (e.g., zoom and pan).
7. Draw geometric components using straight and curved lines.
8. Create and modify borderlines and title block.
9. Modify geometric components (e.g., copy, trim, scale, and stretch).
10. Modify geometric properties (e.g., layer, color, line weight, and type).
11. Use inquiry commands to extract drawing data (e.g., list, distance, and area).
12. Annotate drawings to include text and dimensions.
13. Create, retrieve, edit, and use symbol libraries.
14. Utilize paper space and create viewports.
15. Plot/print drawing to appropriate scale.
16. Use software help features.

C. DEMONSTRATE GEOMETRIC CONSTRUCTION SKILLS

Proficient drafters demonstrate appropriate geometric drawing skills. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Draw straight, tangent, and parallel lines.
2. Draw arcs, circles, and curves.
3. Draw polygons and ellipses.
4. Bisect and divide lines, arcs, circles, and angles.

D. DEMONSTRATE DIMENSIONING SKILLS

Proficient drafters demonstrate appropriate dimensioning skills. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Set and control dimensioning styles.
2. Dimension using aligned and unidirectional dimensioning systems.
3. Dimension using leaders for notes, arcs, and circular features.
4. Dimension using dual dimensioning skills.
5. Dimension using tolerances.

E. DEMONSTRATE ORTHOGRAPHIC PROJECTIONS

Proficient drafters demonstrate appropriate orthographic projection skills. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Draw standard orthographic views.
2. Draw inclined and oblique surfaces.
3. Draw curved surfaces.
4. Draw surface intersections.
5. Identify 1st- and 3rd-angle projection drawings.

6. Draw a 3rd-angle projection drawing.

F. DEMONSTRATE SKILLS TO PRODUCE TECHNICAL ILLUSTRATIONS

Proficient drafters demonstrate appropriate skills for producing technical illustrations. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Draw isometric projections.
2. Draw oblique projections.

G. DEMONSTRATE SKILLS TO PRODUCE SECTIONAL VIEWS

Proficient drafters demonstrate appropriate skills for producing sectional view. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Demonstrate section line and symbol techniques.
2. Identify and draw various types of sectional views.

H. DEMONSTRATE SKILLS TO PRODUCE AUXILIARY VIEWS

Proficient drafters demonstrate appropriate skills for producing auxiliary view. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Demonstrate the ability to determine the true length of a line.
2. Draw a primary auxiliary view.

I. DEMONSTRATE SKILLS TO PRODUCE DETAILED MACHINE DRAWINGS

Proficient drafters demonstrate appropriate skills for producing detailed machine drawings. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Identify use and applications of threads and fasteners.
2. Draw or insert fasteners.
3. Identify a fillet and a round and tell where and why each is used.
4. Produce a set of detail drawings.
5. Create a detailed parts list.
6. Select appropriate drawing layout and scale.
7. Produce a machine assembly drawing.
8. Identify various manufacturing processes.

J. DEMONSTRATE SKILLS TO PRODUCE 3-D DRAWINGS

Proficient drafters demonstrate appropriate skills for producing 3-D drawings. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Create and modify solid models.
2. Produce 2-D projections from 3-D models.

K. ADDITIVE MANUFACTURING TECHNOLOGIES

Proficient drafters are familiar with additive manufacturing technologies. The following accountability criteria are considered essential for students in the Mechanical Design program of study.

1. Explain current and emerging 3D printing applications in a variety of industries.
2. Describe the advantages and limitations of each 3D printing technology.
3. Evaluate real-life scenarios and recommend the appropriate use of 3D printing technology.
4. Identify opportunities to apply 3D printing technology for time and cost savings.
5. Discuss the economic implications of 3D printing including its impact on startup businesses and supply chains.
6. Design and print objects containing moving parts without assembly.

Course Materials, Resources, and Equipment Listing

Course Academic Standards and Indicators