Prepared by: P. Blake
Reviewed by: G. Golling
Reviewed by: S. Aunai
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Engineering (ENGR) 1510 Engineering Graphics and Introduction to Design with Lab (3 Units) CSU:UC

Prerequisite: Successful completion of Math 1060 Intermediate Algebra with a grade of 'C' or better

Prerequisite knowledge/skills: Before entering the course the student should be able to:

1. identify numbers as belonging to specified sets, and graph discrete and continuous sets of real numbers,
2. perform the basic arithmetic operations with positive and negative real numbers, plus raising to powers,
3. know and apply the rules of exponents and the order of operations in algebraic calculations,
4. apply the properties of addition and multiplication for real numbers and identify their use in practice,
5. solve linear equations and inequalities in one variable, and analyze and solve applications leading to such equations or inequalities,
6. solve and graph the solutions of compound inequalities or absolute value inequalities in one variable,
7. perform addition, subtraction, multiplication and division of polynomials,
8. factor simple polynomials, with special emphasis on trinomials quadratic in form, and solve related polynomial equations,
9. add, subtract, multiply and divide rational algebraic expressions, and simplify to lowest terms,
10. solve equations involving rational algebraic expressions, and analyze and solve word problems leading to such equations,
11. simplify radical expressions involving numbers and/or variables,
12. use fractional exponents,
13. perform addition, subtraction, multiplication and division of expression involving

Advisory: Eligibility for English 1500 strongly recommended

Total Hours: 32 hours lecture; 48 hours lab (80 hours total)

Catalog Description: This course covers the principles of developing engineering 3D designs and 2D drawings including proper design, dimension and visualization techniques. Topics include the engineering design process and the development of skills to create and properly use part and assembly relationships, visualization skills, orthographic projections and mechanical dimensioning and tolerancing practices. The use of CAD software, 3D printing and plotting is an integral part of the course.

Type of Class/Course: Transfer Degree Credit

Text: Plantenberg, Kirstie. *Engineering Graphics Essentials with AutoCAD 2014*. Mission: SDC
            Publications, 2013. Print.

Manual: Shih, Randy H. *Tools for Design Using AutoCAD 2014 and Autodesk Inventor 2014: Hand*

Sketching, 2D Drawing and 3 D Modeling. Mission: SDC Publications, 2013. Print.

Course Objectives:

By the end of the course a successful student will be able to:

1. Apply the engineering design process to a design project,
2. Use CAD software to create:
    o 3 Dimensional (3D) models and assemblies
    o 2 Dimensional (2D) engineering part and assembly drawings,
3. Apply rules of orthographic projection to create multi-view drawings,
4. Create pictorials from orthographic views,
5. Create auxiliary and section views of an object following correct conventions, and
6. Apply standards of dimensioning and tolerancing to engineering drawings.

Course Scope and Content (Lecture):

Unit I   Engineering Design
                A. Principles of Design
                B. Types and Tradeoff Decisions
                C. Designing in 3D

Unit II   Basic Engineering Drawing Concepts and Types
                A. Detail, Assembly, Manufacturing Process
                B. Format, ANSI (American National Standard Institute) Standards
                C. Other drawing types: Process, Schematic, Architectural

Unit III   Visualization skills
                A. Conceptualization
                B. Sketching

Unit IV   3D Solid Modeling
                A. Viewing Concepts
                B. Geometry Creation Options
                C. Solids and Surfaces
                D. Parametric Dimensions
                E. Linking with Computer Aided Manufacturing (CAM) and Engineering Analysis

Unit V   2D Drawing Generation
                A. Detail and Assembly
                B. Electronic vs. physical drawing
                C. Drawing Management
                D. Bills of Material (BOM's)

Unit VI   Views
                A. Multi-view – purpose and projections
                B. Line Types – object, hidden, center, break
                C. Auxiliary Views – purpose and type
                D. Section Views - Purpose and Types

Unit VII   Scales
     A. Purpose in engineering and architect
     B. Typical Factors
     C. Callouts

Unit VIII   Dimensioning & Tolerancing
     A. ANSI Standards
     B. Lines, positions, size
     C. Three Techniques
     D. GD&T (Geometric Design & Tolerances)

Unit IX   Fasteners & Welding
     A. Types and Purposes
     B. Symbols
     C. Drill Callouts

Course Scope and Content (Lab):

Unit I   Starting CAD System
     A. Basic Commands
     B. Coordinates & Views
     C. Toolbars and Menus
     D. Units of Measure and Scale
     E. Help

Unit II   3D Modeling
     A. Coordinate Systems
     B. Viewpoints
     C. Sketching
     D. Geometry Creation
     E. Parametric Dimensioning
     F. Part Assemblies
     G. Types: solid, wireframe, surface

Unit III   Viewing Commands
     A. Pan
     B. Zoom
     C. Scroll
     D. Views

Unit IV   Drawing Creation
     A. Automatic Generation
     B. View Placement
     C. Title Block and Format

Unit V   Edit
     A. Selection Sets
     B. Erase
     C. Copy, Mirror, Move, Offset, Array
     D. Trim, Fillet, Break, Lengthen

Unit VI   Organize
           A. Layers & Line types
           B. Colors
           C. Blocks

Unit VII   Text and Hatch
           A. Style
           B. Justification
           C. Edit
           D. Patterns
           E. Areas

Unit VIII   Dimensioning
           A. Types (linear, radial, angular, ordinate)
           B. Edit
           C. Tolerancing

Unit IX   Getting Information
           A. Lists
           B. Measure
           C. Locations
           D. Volumes, Areas and Perimeters

Learning Activities Required Outside of Class:

The students in this class will spend a minimum of 4 hours per week outside of the regular class time doing the following:

1.   Studying assigned text, handout materials and class notes
2.   Reviewing and preparing for quizzes, midterm and final exams
3.   Completing individual projects using the CAD software including sketches, models, drawings, assemblies and assembly drawings

Methods of Instruction:

1.   Lecture, demonstrations and discussions
2.   Individual projects with emphasis on hands-on work by applying lecture principles on the CAD system software
3.   Group projects with emphasis on design creativity, problem solving and teamwork

Methods of Evaluation:

1.   Quizzes
2.   Exams
3.   Participation
4.   Individual and group assignments & projects
5.   Oral presentations

6.   Design project

Laboratory Category: Extensive Laboratory

Pre delivery criteria: All of the following criteria are met by this lab.
1.   Curriculum development for each lab.
2.   Published schedule of individual laboratory activities.
3.   Published laboratory activity objectives.
4.   Published methods of evaluation.
5.   Supervision of equipment maintenance, laboratory setup, and acquisition of lab materials and supplies.

During laboratory activity of the laboratory: All of the following criteria are met by this lab.
1.   Instructor is physically present in lab when students are performing lab activities.
2.   Instructor is responsible for active facilitation of laboratory learning.
3.   Instructor is responsible for active delivery of curriculum.
4.   Instructor is required for safety and mentoring of lab activities.
5.   Instructor is responsible for presentation of significant evaluation.

Post laboratory activity of the laboratory: All of the following criteria are met by this lab.

1.   Instructor is responsible for personal evaluation of significant student outcomes (lab exercises, exams, practicals, notebooks, portfolios, etc.) that become a component of the student grade that cover the majority of lab exercises performed during the course.
2.   Instructor is responsible for supervision of laboratory clean up of equipment and materials.