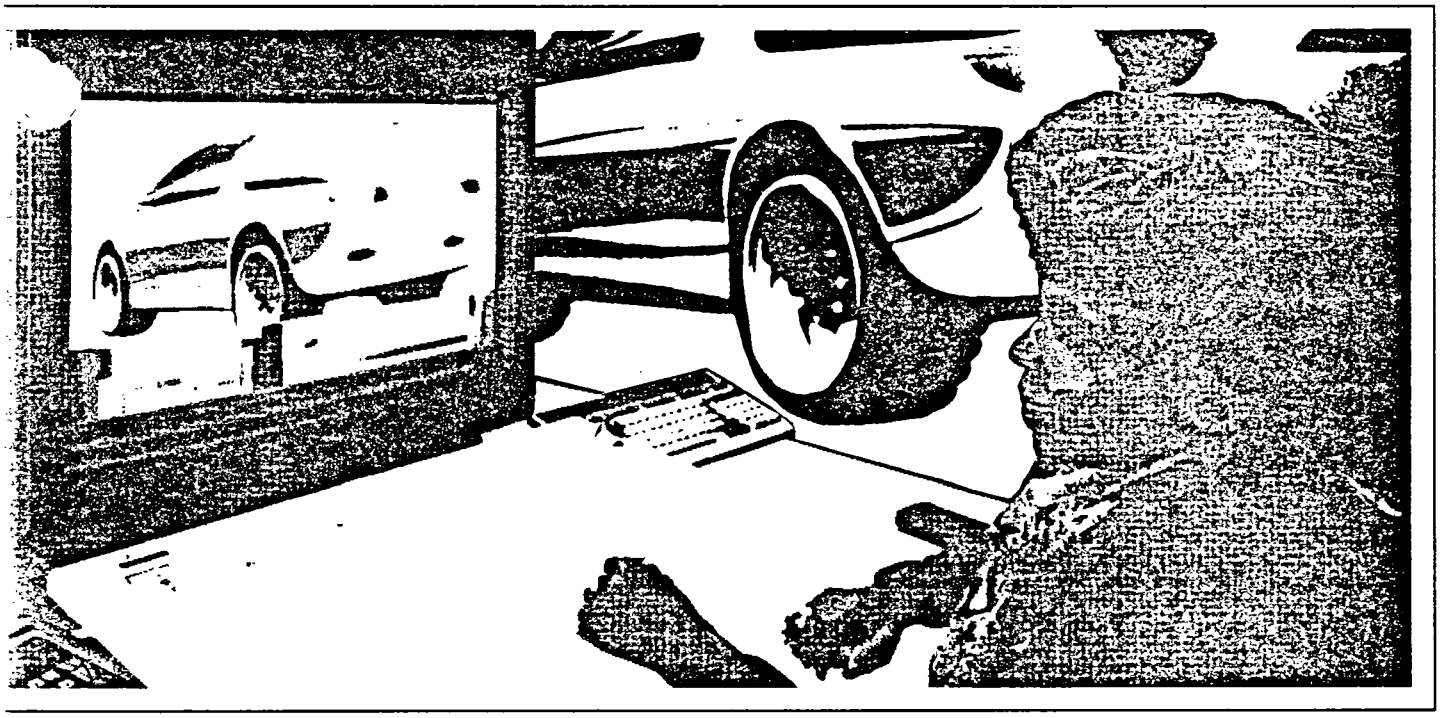
TECHNOLOGY EDUCATION
COMPUTER AIDED DESIGN (CAD)

GRADES 9-12
ELECTIVE



The University of the State of New York
The State Education Department
Bureau of Home Economics
and Technology Education Programs
Division of Occupational Education
Albany, New York 12234

THE UNIVERSITY OF THE STATE OF NEW YORK
Regents of The University

R. Carlos Carballada, *Chancellor*, B.S. . . . . . **Rochester**
Jorge L. Batista, *Vice Chancellor*, B.A., J.D. . . . . . **Bronx**
Willard A. Genrich, *Chancellor Emeritus*, LL.B. . . . . . **Buffalo**
Emlyn I. Griffith, A.B., J.D. . . . . . **Rome**
Louise P. Matteoni, B.A., M.A., Ph.D. . . . . . **Bayside**
J. Edward Meyer, B.A., LL.B. . . . . . **Chappaqua**
Floyd S. Linton, A.B., M.A., M.P.A. . . . . . **Miller Place**
Mimi Levin Lieber, B.A., M.A. . . . . . **New York**
Shirley C. Brown, B.A., M.A., Ph.D. . . . . . **Albany**
Norma Gluck, B.A., M.S.W. . . . . . **New York**
Adelaide L. Sanford, B.A., M.A., P.D. . . . . . **Hollis**
Walter Cooper, B.A., Ph.D. . . . . . **Rochester**
Carl T. Hayden, A.B., J.D. . . . . . **Elmira**
Diane O'Neill McGivern, B.S.N., M.A., Ph.D. . . . . . **Staten Island**
Saul B. Cohen, B.A., M.A., Ph. D. . . . . . **New Rochelle**
James C. Dawson, A.A., B.A., M.S., Ph.D. . . . . . **Peru**

President of The University and Commissioner of Education
Thomas Sobol

Executive Deputy Commissioner of Education
Thomas E. Sheldon

Deputy Commissioner for Elementary, Middle and Secondary Education
Arthur L. Walton, Jr.

Assistant Commissioner for Curriculum and Assessment
Edward T. Lalor

The State Education Department does not discriminate on the basis of age, color, religion, creed, disability, marital status, veteran status, national origin, race, gender or sexual orientation in the educational programs and activities which it operates. Portions of this publication can be made available in a variety of formats, including braille, large print or audio tape, upon request. Inquiries concerning this policy of equal opportunity and affirmative action should be referred to the Department's Affirmative Action Officer, NYS Education Department, 89 Washington Avenue, Albany, NY 12234.

OVERVIEW AND RATIONALE

Computer Aided Design (CAD) is a one-unit, 40-week course that will expose the student to CAD terminology, history, components, applications, design functions and careers. A school district may elect to offer a 1/2 unit of Computer Aided Design, providing modules I through V are covered.

The majority of the time spent in this course will consist of using a CAD system to solve graphic problems. Emphasis will be placed on the use of a CAD system for design applications. Students will acquire technical drawing skills and an understanding of industrial standards and codes, and recognize the current methods of generating hardcopy. Students will understand how CAD and computer technology is changing the role of drafting and what effects this will have on the design and manufacturing process.

This course is available to all students, and may be taken as an elective or applied to a technology or drafting sequence.

USE IN SEQUENCE: Elective course

This course is one of the New York State approved electives in Technology Education. It is one of several electives courses designed to give students a firm but broad exploration of the technical world in which they live.

Students completing a high school sequence in Technology Education must take a total of 1-3 units of elective course work to fulfill the "elective" portion of their sequence requirement. This course may also be taken by any student as an elective. If the instructor uses this syllabus as a guide for instruction, students may be granted Regents credit for the experience.

Several courses within Technology Education offerings can be offered on a 1/2-unit or 1-unit basis. Course work earning 1/2-unit must comprise a minimum of 54 hours of instruction and course work earning 1-unit must comprise a minimum of 108 hours of instructional time.

Students with Disabilities

The Board of Regents, through the part 100 Regulations of the Commissioner, the Action Plan, and The Compact for Learning, has made a strong commitment to integrating the education of students with disabilities into the total school program. According to Section 100.2(s) of the Regulations of the Commissioner of Education, "Each student with a handicapping condition as such term is defined in Section 200.1(ii) of this Chapter, shall have access to the full range of programs and services set forth in this Part to the extent that such programs and services are appropriate to such student's special educational needs." Districts must have policies and procedures in place to make sure that students with disabilities have equal opportunities to access diploma credits, courses, and requirements.

The majority of students with disabilities have the intellectual potential to master the curricula content requirements for a high school diploma. Most students who require special education attend regular education classes in conjunction with specialized instruction and/or related services. These students must attain the same academic standards as their nondisabled peers to meet graduation requirements, and, therefore, must receive instruction in the same content areas, at all grade levels. This will ensure that they have the same informational base necessary to pass statewide testing programs and meet diploma requirements.

Teachers certified in the subject area should become aware of the needs of students with disabilities who are participating in their classes. Instructional techniques and materials must be modified to the extent appropriate to provide students with disabilities the opportunity to meet diploma requirements. Information or assistance is available through special education teachers, administrators, the Committee on Special Education (CSE) or student's Individualized Education Program (IEP).

Strategies for Modifying Instructional Techniques and Materials

1. Students with disabilities may use alternative testing techniques. The needed testing modification must be identified in the student's Individualized Education Program (IEP). Both special and regular education teachers need to work in close cooperation so that the testing modifications can be used consistently throughout the student's program.

2. Identify, define and pre-teach key vocabulary. Many terms in this syllabus are specific and some students with disabilities will need continuous reinforcement to learn them. It would be helpful to provide a list of these key words to the special education teacher in order to provide additional reinforcement in the special educational setting.

3. Assign a partner for the duration of a unit to a student as an additional resource to facilitate clarification of daily assignments, timelines for assignments, and access to daily class notes.

4. When assigning long-term projects or reports, provide a timeline with benchmarks as indicators for completion of major sections. Students who have difficulty with organizational skills and time sequence may need to see completion of sections to maintain the organization of a lengthy project or report.

Infusing Awareness of Persons with Disabilities Through Curriculum

In keeping with the concept of integration, the following subgoal of the Action plan was established.

In all subject areas, revisions in the syllabi will include materials and activities related to generic subgoals such as problem solving, reasoning skills, speaking, capacity to search for information, the use of libraries and increasing student awareness of and information about the disabled.

The purpose of this subgoal is to ensure that appropriate activities and materials are available to increase student awareness of disabilities.

This curriculum, by design, includes information, activities, and materials regarding persons with disabilities. Teachers are encouraged to include other examples as may be appropriate to their classroom or the situation at hand.

STUDENT LEADERSHIP SKILLS

Development of leadership skills is an integral Part of occupational education in New York State. The New York State Education Department states that, "Each education agency should provide to every student the opportunity to participate in student leadership development activities. All occupational education students should be provided the opportunity to participate in the educational activities of the student organization(s) which most directly relate(s) to their chosen educational program."

Leadership skills should be incorporated in the New York State occupational education curricula to assist students to become better citizens with positive qualities and attitudes. Each individual should develop skills in communications, decision making/problem solving, human relations, management, and motivational techniques.

Leadership skills may be incorporated into the curricula as competencies (Performance Objectives) to be developed by every student or included within the Suggested Instructional Strategies. Teachers providing instruction through occupational educational curricula should familiarize themselves with the competencies. Assistance may be requested from the State advisor of the occupational student organization related to the program area.

Students who elect to become active members of one of the student leadership organizations chartered by the New York State Education Department have the advantage of the practical forum to practice leadership skills in an action oriented format and have the potential for recognition of their achievements at the local, State, and national level.

SYLLABUS OBJECTIVES

Through the implementation of this syllabus the student will be able to:

1. Describe the evolution of CAD, its features, limitations, career opportunities, and impact on society.
2. Identify the components and their function within a CAD workstation.
3. Demonstrate an understanding of industrial standards and codes, and their relationship to specific engineering graphics fields.
4. Use the CAD system as a tool to access, organize, analyze and communicate information.
5. Generate and communicate realistic solutions and documentation to design problems within an integrated design process.
6. Demonstrate a variety of problem-solving competencies and an understanding of the methods and practices appropriate to industrial design, analysis and simulation.
7. Understand how a CAD system is used to create a manufacturing data base that will increase accuracy and productivity by improving the interface between the design and manufacturing processes.
8. Understand the different forms of geometric modeling and how they are used to represent the structure and behavior of objects for engineering analyses and design.

PERFORMANCE OBJECTIVES

The performance objectives of the syllabus are intended to clearly present what students are expected to know, do and be like, following instruction in a given topic. The knowledge (**K**), skills (**S**) and attitudes (**A**) that students should acquire are identified for each topic, under "competencies to be developed".

SYLLABUS OUTLINE
Table of Contents

CAD

	Estimated Learning Time
I. Module: **Fundamentals of CAD**	**2 hours**
Topics:	
A. Evolution of CAD and its Terminology	40 minutes
B. Application of Computers for Design and Drafting	40 minutes
C. Benefits, Careers, and Impact of Computer Aided Design	40 minutes
II. Module: **Components of a Computer Aided Design System**	**4 hours**
Topics:	
A. Central Processing Unit	40 minutes
B. Secondary Storage Devices	1 hour
C. Display Terminals	40 minutes
D. Operator Input Devices	40 minutes
E. Hardcopy and other Output Devices	1 hour
III. Module: **Fundamental Operation of a CAD System**	**8 hours**
Topics:	
A. Systems Software Configuration and Operation	1 hour
B. Coordinate Systems and Basic Geometric Construction	3 hours
C. Setting Drawing Aids and Parameters	2 hours
D. File Management and Transfer	2 hours
IV. Module: **Drawing Development and Editing**	**16 hours**
Topics:	
A. Drawing Functions	4 hours
B. Editing Functions	4 hours
C. Display Control Functions	4 hours
D. Information Retrieval	4 hours
V. Module: **CAD Applications**	**24 hours**
Topics:	
A. Technical Drawings	15 hours
B. Industrial Standards and Codes	3 hours
C. Dimensioning and Annotating Drawings	4 hours
D. Plotting Drawings	2 hours

	Estimated Learning Time
VI. Module: **Geometric Modeling**	**32 hours**
Topics:	
A. 3D Wireframe Modeling	12 hours
B. Constructing Solid Models	12 hours
C. Engineering Analysis	3 hours
D. Shading and Animating Models	5 hours
VII. Module: **Design Development and Evaluation**	**22 hours**
Topics:	
A. Identification of the Problem	2 hours
B. Research and Analysis	4 hours
C. Implementing a Solution	8 hours
D. Design Testing and Evaluation	4 hours
E. Portfolio Generation and Presentation	4 hours
TOTAL ESTIMATED LEARNING TIME:	**108 HOURS**

CAD
Syllabus Component

Estimated Learning Time

I. Module: **Fundamentals of CAD**

A. Topic: **Evolution of CAD and its Terminology** **40 minutes**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will be able to explain how the field of drafting has evolved historically and have an understanding of common acronyms used in the fields of computer aided drafting and manufacturing.

   Competencies to be Developed:
   After studying this topic, the student will be able to:
   a. Explain the function of drafting and how it has become a technical communication medium.**(K)**
   b. Compare traditional drafting methods and tools to CAD and explain how they differ.**(K)**
   c. Understand the evolution of computer technology and how it relates to computer graphics.**(K)**

   Suggested Instructional Strategies:

   1. Have students research and develop a time line of drafting and computer technology.

   2. Have students, singly or in groups, give a presentation on a key development in the evolution of computer technology and how it relates to CAD and computer graphics.

   3. Compare the differences in traditional drafting methods and computer aided design.

B. Topic: **Application of Computers for Design and Drafting** **40 minutes**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will be able to explain how a computer aided design system is utilized in design verification and analysis, what computer modeling is, and how it is used in determining a final design solution.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Define the major applications of CAD.**(K)**
   b. Understand how a CAD data base is used in all stages of manufacturing. **(K)**
   c. Understand the role and responsibilities of CAD specialists.**(K)** **(A)**
   d. Know how CAD principles are applied in different fields of industry.**(K)**

   Suggested Instructional Strategies:

   1. Demonstrate how a CAD data base is used in each phase of the manufacturing process.

   2. Discuss the primary fields of CAD specialization.

   3. Participate in field trips to local industry which uses CAD.

   4. Discuss CAD related topics based uponinformation gathered from guest lecturers and\or video tapes on computer aided design and drafting.

C. Topic: **Benefits, Career and Impact of Computer Aided Design** **40 minutes**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will be able to explain the benefits, career opportunities and impact of CAD on the design and manufacturing process.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Know how a CAD system increases productivity.**(K)**
   b. Explain how a CAD system permits a more thorough engineering analysis and the investigation of a larger number of design alternatives.**(K)**
   c. Identify career opportunities and educational requirements.**(K)**
   d. Understand how CAD and computer technology is changing the role of drafting and what effects this will have on the design and manufacturing process.**(K)**

Suggested Instructional Strategies:

1. Have students develop a checklist of potential benefits of the implementation of CAD.

2. Have students research and list the specialized skills needed by CAD operators in various industries.

3. Instruct each student to research and present a report on the type of formal education needed for a CAD operator in the field of his or her choice.

II. Components of a Computer Aided Design System

A. Topic: **Central Processing Unit** **40 minutes**

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to explain the function of the Central Processing unit and how it affects the operation of a CAD system.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Define the terms digital computer, microprocessor, microcomputer, minicomputer and mainframe.**(K)**
b. List and explain the basic functions of a computer.**(K)**
c. Identify the microprocessor, memory and input units of a microcomputer and explain their function.**(K)**
d. Explain the basic function of computer memory and how it affects a CAD workstation.**(K)**

Suggested Instructional Strategies:

1. Ask Students to identify the different classifications of computers and explain how they are used.

2. Have students write reports describing the basic operation of a microcomputer and how hardware and software interact.

3. Have students identify and explain the function of each major internal part of a microcomputer.

B. Topic: **Secondary Storage Devices** **1 hour**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will be able to explain the purpose of data storage devices and their function within a CAD workstation.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Name the types of mass-storage peripherals used with micro-computers.**(K)**
   b. Understand the function of magnetic tapes, floppy disks, microdisks, hard disk drives and optical disks.**(K)**
   c. Demonstrate the proper use and care of floppy disks.**(K) (A)**
   d. Demonstrate proper file management and naming procedure.**(S)**

   Suggested Instructional Strategies:

   1. Have students explain the different methods of storing data when working with computers.

   2. Have students demonstrate how to format and care for a floppy disk.

   3. Have students explain classroom file management and proper naming procedure.

C. Topic: **Display Terminals** **40 minutes**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will be able to describe the operation of a video graphics terminal and how it functions within a CAD workstation.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Identify the different types of cathode ray tubes used with a CAD system.**(K)**
   b. State the different forms of flat screen display technology and how it differs from conventional display devices.**(K)**
   c. Identify the various levels of display resolution and how they relate to pixel density.**(K)**

Suggested Instructional Strategies:

1. Have students explain the basic techniques used for generating computer graphics on a cathode ray tube.

2. Have students define the term screen resolution and explain how it is effected by pixel density.

3. Discuss the different forms of flat screen display technology.

D. Topic: **Operator Input Devices** **40 minutes**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will be able to describe the different devices used by a CAD operator to input information into a CAD system.

   Competencies to be Developed:
   After studying this topic, the student will be able to:
   a. Identify the various types of input devices. **(K)**
   b. Explain how input devices allow a operator to communicate with a CAD system.**(K)**
   c. Discuss the advantages and disadvantages of various input devices.**(K)**

   Suggested Instructional Strategies:

   1. Have students demonstrate the correct operation of various input devices.

   2. Have students explain the basic operating principles behind each input device.

   3. Discuss the advantages and disadvantages of each input device.

E. Topic: **Hardcopy and Other Output Devices** **1 hour**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will use various types of hardcopy devices to produce CAD images on paper or vellum.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Name the various devices used to produce hardcopies on the CAD system.(K)
b. Explain the difference between plotters, printers and display recorders.(K)
c. Discuss the technologies behind the operation of various output devices.(K)
d. Identify the advantages and disadvantages of various hardcopy devices.(K)

Suggested Instructional Strategies:

1. Have students demonstrate the proper use of a variety of hardcopy devices used on CAD systems.

2. Ask students to explain how these devices produce images on paper for vellum.

3. Discuss hardcopy specifications, such as accuracy, resolution, repeatability and speed.

II. Module: **Fundamental Operation of a CAD System**

A. Topic: **Systems Software Configuration and Operation** **1 hour**

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will understand the basic steps involved in setting up and operating a CAD system.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Describe the difference between a computer's operating system and the CAD software.(K)
b. List and explain the basics steps need to configure and start the CAD system.(K)
c. Identify the different parts of the CAD system's drawing editor and its menu structure.(K)

Suggested Instructional Strategies:

1. Provide students with exercises that will promote an understanding of the operating system used by the CAD system.

2. Provide students with the correct procedure for starting the CAD system and setting up a new drawing.

3. Explain the CAD systems drawing editor and how to manipulate its menu structure.

B. Topic: **Coordinate Systems and Basic Geometric Construction** **1 hour**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will use the CAD system's Chartering coordinate system to develop basic geometric constructions.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Perform the function and procedures for using a keyboard, screen menu and graphic tablet when communicating with the CAD system.(K)
   b. Use various coordinate systems to enter geometry into the CAD system.(K)
   c. Enter lines, arcs, circles, points and polygons on the CAD systems.(S)
   d. Explain the importance of the CAD system's prompt area.(A)

   Suggested Instructional Strategies:

   1. Demonstrate the sequences used in CAD drawing compared to instrument drawing.

   2. Provide students with exercises that use the various coordinate systems found on the CAD system.

C. Topic: **Setting Drawing Aids and Parameters** **2 hours**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will understand the importance of planning a drawing and establishing drawing aids and parameters.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Explain the value of planning and importance of good system management.**(K) (A)**
b. Explain the correct use of limits, grid, snap and coordinates.**(K)**
c. Demonstrate the difference between scientific, decimal engineering and architectural units of measurement.**(S)**
d. Identify the correct view selection and command sequence needed to begin a drawing.**(K)**

Suggested Instructional Strategies:

1. Provide students with an opportunity to plan and set up various of drawing parameters for a variety of drafting disciplines.

2. Provide students with a drawing plan sheet that will aid them in view selection, command sequence and file management.

D. Topic: **File Management and Transfer** **2 hours**

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will understand the importance of a sound file management system and the need for file transfer to various software packages.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Save and end a drawing.**(K)**
b. Explain the reason for developing a file management system and naming procedure.**(K)**
c. Explain the need for file backup and periodic saving of drawing files.**(K)**
d. Recognize the need to transfer drawing files to various software packages for engineering analysis and post processing.**(K)**

Suggested Instructional Strategies:

1. Provide students with an appropriate file management system.

2. Have students demonstrate the various methods of file transfer.

3. Discuss the importance of file backup and periodic saving of drawing files.

IV. Module: **Drawing Development and Editing**

A. Topic: **Drawing Functions** **4 hours**

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to define and demonstrate the drawing functions available on a CAD system.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Define the drawing functions available.(K)
b. Select the correct drawing function for each application.(K).
c. Draw lines, circles, arcs, points, polygons, fillets, chamfers and irregular curves.(S)
d. Use drawing aids available to correctly place or position drawing entities.(S)
e. Create various linetypes, linewidths and line colors.(S)

Suggested Instructional Strategies:

1. Have students produce technical drawings using CAD drawing commands.
2. Have students select and use the most effective command structure and drawing aids.
3. Have students demonstrate the effectiveness of using color, correct linetypes and linewidths.

B. Topic: **Editing Functions** **4 hours**

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to describe and demonstrate the editing process.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Identify the methods of selecting and editing drawing entities.(K)
b. Use editing commands to delete, restore and manipulate drawing entities.(S)
c. Resize an entity or group of entities by scaling or stretching.(S)
d. Separate, move, copy, array and rotate a drawing entity.(S)

Suggested Instructional Strategies:

1. Have students use various selection methods to edit drawing entities.

2. Have students make changes to a CAD drawing that will require the use of various editing commands.

3. Demonstrate and discuss the advantages of the editing commands.

C. Topic: **Display Control Functions** **4 hours**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will be able to identify the purpose of the display controls and manipulate data using display commands.

   Competencies to be Developed:
   After studying this topic, the student will be able to:
   a. Identify the purpose of various display commands.**(K)**
   b. Enlarge a portion of a drawing, move across an enlarged view of a drawing, reduce the drawing magnification and display specific views of a drawing.**(S)**
   c. Control the display of construction lines, reference points, communications text and display color.**(S)**
   d. Manipulate the display resolution which will effect regeneration and the appearance of an arc, curve or circle.**(S)**

   Suggested Instructional Strategies:

   1. Have students demonstrate the ability to quickly move about the CAD drawing using the display commands.

   2. Discuss the function and advantages of the display controls.

   3. Make comparisons of the effect of display options on redraw time, appearance and convenience.

D. Topic: **Information Retrieval** **4 hours**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will be able to monitor a CAD drawing data base to determine specific measurements and properties of drawing entities.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Produce a data base list of information about the entire drawing or specific objects.(S)
b. Measure a specific distance, angle and area.(S)
c. Explain the importance of the capability of the CAD system to calculate mass properties and finite element analysis.(K)

Suggested Instructional Strategies:

1. Have students list information relevant to an object within a drawing.

2. Have students measure a specific distance, angle and area of a drawing.

3. Discuss the advantages of CAD information retrieval.

V. Module: **CAD Applications** **15 hours**

A. Topic: **Technical Drawings**

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to use the CAD system to develop technical drawings to document an idea.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Describe the techniques used to plan and construct a technical drawing using CAD.(K)
b. Plan and construct technical drawings with the use of CAD drawing aids and drawing, editing, display control and information retrieval functions.(S)
c. Identify construction tips that enhance productivity.(K)

Suggested Instructional Strategies:

1. Have students plan and construct a technical drawing from a list of specifications.

2. Analyze the design, and the functions of the CAD system to determine which commands are best to create the object.

B. Topic: **Industrial Standards and Codes** **3 hours**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will be able to identify and apply industrial standards and codes to CAD technical drawings.

   Competencies to be Developed:
   After studying this topic, the student will be able to:
   a. Identify standardized dimensioning symbols.**(K)**
   b. Identify and use ANSI dimensional standards for customary and metric dimensions.**(K)**
   c. Understand the concept of and need for, standardization of drawings.**(K)**

   Suggested Instructional Strategies:

   1. Describe the purpose of ANSI and ISO drafting standards.

   2. Have students plan and produce a layout sheet and title block following ANSI standards.

   3. Have students locate the ANSI standards for line conventions, dimensioning, tolerance, threads, gears, materials, and multiview, sectional-view and pictorial drawings.

C. Topic: **Dimensioning and Annotating Drawings** **4 hours**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will be able to fully dimension a working drawing using ANSI standards and apply specific notes for manufacturing features.

   Competencies to be Developed:
   After studying this topic, the student will be able to:
   a. Apply both size and location dimensions to a drawing.**(S)**
   b. Use both lineal and angular dimensions on a drawing.**(S)**
   c. Interpret and use correct tolerance techniques.**(K)**
   d. Explain the need for and use of, datum dimensioning.**(K)**

Suggested Instructional Strategies:

1. Have students explain and apply dimensioning standards as interpreted by ANSI.

2. Have students apply specific notes for manufacturing features.

3. Prepare completely dimensioned multiview drawings from engineering sketches and industrial drawings.

D. Topic: **Plotting Drawings** **2 hours**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will be able to set up the plotter, select specifications and select and load pen and medium to produce a high-quality hardcopy print of correct scale.

   Competencies to be Developed:
   After studying this topic, the student will be able to:
   a. Identify plot specifications which determine how the plotted drawing will appear.(**K**)
   b. Recognize the properties of various plotter media.(K)
   c. Select plotter pens compatible with different media.(**S**)

   Suggested Instructional Strategies:

   1. Have students list the sequential steps for plotting a drawing.

   2. Demonstrate the correct plotting procedure.

   3. Change specifications for desired paper size, plot origin, scale or pen type.

VI. Module: **Geometric Modeling**

A. Topic: **3D Wireframe Modeling** **12 hours**

1. Upon satisfactory completion of this topic, the student will recognize the benefits of computer-generated 3D models and their applications in various industries.

Competencies to be Developed:

After studying this topic, the student will to be able:

a. Explain that 3D drawings can be the result of isometric, diametric, trimetric, oblique or perspective projection.**(K)**
b. Describe the procedures for constructing a 3D model using three-dimensional coordinate geometry.**(K)**
c. Specify the methods of viewing 3D models from various viewpoints.**(K)**
d. Recognize the need for 3D surface modeling and shading for boundary representation. **(K)**

Suggested Instructional Strategies:

1. Demonstrate how 3D models can be extruded from two-dimensional geometry.

2. Using the CAD system, have students create 3D wireframe models by constructing three-dimensional coordinate geometry.

3. Have students explain the steps involved in the shading of a 3D wireframe model.

B. Topic: **Constructing Solid Models** **12 hours**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will understand the principles of solid modeling and recognize how a solid model is used in engineering analysis.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Create solid primitives using the CAD system.**(S)**
   b. Create composite solids from primitives.**(S)**
   c. Edit existing solids models.**(S)**
   d. Generate two-dimensional geometry from a solid model.**(S)**

Suggested Instructional Strategies:

1. Have Students define solids modeling and describe how it is used in the design of a product.

2. Have students illustrate the differences between 3D wireframe and solid modeling.

3. Provide students with the opportunity to create and analyze solid models.

C. Topic: **Engineering Analysis** **3 hours**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will recognize the importance of engineering analysis in determining the final design solution.

   Competencies to be Developed:
   After studying this topic, the student will be able to:
   a. Describe common design analysis functions.**(K)**
   b. Explain the importance of mass property and finite-element analysis in determining a final design solution.**(K) (A)**
   c. Explain how industry uses engineering analysis to improve product design.(K)

   Suggested Instructional Strategies:

   1. Have students articulate the need for engineering analysis and explain its use in the design process.

   2. Have students demonstrate simple mass property analysis on a solid models.
   3. Have students view video tapes which illustrate the use of engineering analysis on a CAD system.

D. Topic: **Shading and Animating Models** **5 hours**

1. **Performance Statement:**
   Upon satisfactory completion of this topic, the student will recognize how shading and animating assist engineers and architects in dynamic analysis of CAD models.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Recognize how shading and animation are applied to a model.(K)
b. Describe the steps involved in preparing a CAD drawing for shading and animating.(K)
c. Identify how engineers use shading and animation to see how a design will behave when it is actually used.(K)

Suggested Instructional Strategies:

1. Have students view video tapes which illustrate the use of shading and animation to test CAD models.

2. Provide students with the opportunity to create a shaded, animated, model of a CAD drawing.

3. Explain how animated models are powerful tools that can significantly reduce the time and effort involved in testing and modifying of a design.

VII. Module: **Design Development and Evaluation**

A. Topic: **Identification of the Problem** **2 hours**

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will realize the design problem and understand the need for specifications.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Identify the design problem to be solved and its essential parts.(K)
b. Explain the design problem constraints and limitations.(K)
c. Understand the design problem as completely as possible before attempting to bring about a solution.(K)

Suggested Instructional Strategies:

1. Have students identify a real world product or need and use the CAD system as a tool to design or redesign a solution.

2. Provide opportunities for students to address a design problem and present a solution through design and drawing exercises.

B. Topic: **Research and Analysis** **4 hours**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will develop ideas and possible solutions to the design problem.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Break the problem into separate, distinct and manageable sub-problems.(S)
   b. Identify similarities with other exercises or more familiar design problems.(K)
   c. Develop ideas based upon the gathering of information through modeling and experimentation.(S)

   Suggested Instructional Strategies:

   1. Have students identify the order in which the problem will be solved, the functions that are involved, the techniques that will be applied, the resources that are currently available and the restrictive time requirements.

   2. Have students develop models and experimentation that will describe, simulate and predict the behavior of the design problem.

C. Topic: **Implementing a Solution** **8 hours**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will synthesize the solution to the design problem by optimizing the research and experimentation data.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Select and develop an optimal solution to the design problem within the allotted time.(S)
   b. Produce a model or prototype of the design solution.(S)
   c. Determine any necessary modifications to the design solution.(S)

   Suggested Instructional Strategy:

   1. Have students produce and compose the final design solution by constructing a model or prototype.

D. Topic: **Design Testing and Evaluation** **4 hours**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will make judgments about the validity of the design solution based upon problem criteria.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Test the design solution to determine accuracy, performance and reliability.**(S)**
   b. Evaluate and make conclusions about the merits of a design solution or engineering design.**(S)**
   c. Identify and document any problems with the design solution and, if necessary, make modifications and re-test.**(K)**

   Suggested Instructional Strategies:

   1. Have students identify evaluation criteria based on problem definition.

   2. If the design was not completely successful an analysis should be made as to why, and suggestions offered to overcome or remedy the problem.

E. Topic: **Portfolio Generation and Presentation** **4 hours**

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will recognize the importance of design documentation and presentation.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Explain that the success of the design solution is dependent on the communication skills of the problem solver.**(K)**
   b. Develop a portfolio documenting the design process.**(S)**
   c. Produce a presentation which will justify and demonstrate the design problem solution.**(S)**

   Suggested Instructional Strategies:

   1. Have students develop a portfolio outline that includes documentation of each step in the design process.

   2. As a class develop a format outline for presentations.

   3. Develop evaluation guidelines based on specific criteria such as, growth and progress, concepts mastered, effort, creativity, using the design process, recording ideas and quizzes.

EQUIPMENT LIST

Suggested equipment to support Instructional Strategies of *Computer Aided Design*

MODULE 1)	CAD System Traditional Drafting Tools VCR, Projector Overhead
MODULE 2)	CAD System VCR, Projector
MODULE 3)	CAD System VCR, Projector
MODULE 4)	CAD System VCR, Projector
MODULE 5)	CAD System Measurement Tools Hard Copy Devices VCR, Projector
MODULE 6)	CAD System Measurement Tools Hard Copy Devices VCR, Projector
MODULE 7)	CAD System Measurement Tools Hard Copy Devices VCR, Projector Cam-Corder Portfolio Binder

*NOTE: What would be *realistic* to carry out the activities to support the syllabus--this will help us in the future in devleoping a facility guide.