Course Title: Pre-Engineering Technology

Course Number: 00904 AM 00954 PM

Course Prerequisites: Industrial Arts, Applied Math or equivalent

Course Description:

15.1301 DRAFTING AND DESIGN TECHNOLOGY/TECHNICIAN, GENERAL Pennsylvania CIP
An instructional program that generally prepares individuals to apply technical knowledge and skills as each relates to gathering and translating of data or specifications including basic aspects of planning, preparing and interpreting mechanical, architectural, chemical, structural, civil, pneumatic, marine, electrical/electronic, topographical and other drawings and sketches used in various engineering fields. Instruction is designed to provide experiences in drawing and CAD; the use of reproduction materials, equipment and processes; the preparation of reports and data sheets for writing specifications; the development of plan and process charts indicating dimensions, tolerances, fasteners, joint requirements and other engineering data; the development of models; and drafting multiple view assembly and sub-assembly drawings as required for manufacture, construction and repair of mechanisms.

Suggested Grade Level: Grades 10-12

Length of Course: _____ One Semester X Two Semesters _____ Other

Three periods per day (120 Min) – Five Days per week – Three years

Units of Credit: 3 / Year

PDE Certification and Staffing Policies and Guidelines (CSPG) Required Teacher Certification(s)

Vocational Instruction – Drafting

Certification verified by WCSD Human Resources Department:

X Yes _____ No
Board Approved Textbooks, Software, Materials:

Textbook

Book Title: AutoCAD and Its Applications Comprehensive 2010, 17th Edition
Publisher: Goodheart-Willcox
ISBN #: 978-1-60525-163-9
Copyright: 2010
Date of Adoption: September 2010

Sample Units:

1. Introduction to AutoCAD
8. Construction Tools and Multiview Drawings
17. Dimension Standards and Styles
18. Linear and Angular Dimensioning
19. Dimensioning Features and Alternate Practices
20. Dimensioning with Tolerances
21. Editing Dimensions
22. Parametric Drafting
23. Section Views and Graphic Patterns
24. Basic Pictorial Drawings
31. Annotative Objects
34. Introduction to Three-Dimensional Modeling
35. Creating Primitives and Composites
36. Mesh Modeling
37. Viewing and Displaying Three-Dimensional Models
38. Using Show Motion to View a Model
39. Understanding Three-Dimensional Coordinates and User Coordinate Systems
41. Text and Dimensions in 3D
42. Solid Model Extrusions and Revolutions
43. Sweeps and Lofts
46. Solid Model Editing

Software

Autodesk Design Academy
BOARD APPROVAL:

Date Written: November 2007 – February 2010
Date Approved: April 12, 2010
Implementation Year: 2010-2011

Tools, Equipment, Supplies, and Materials (DACUM)


Course Standards

PA Academic Standards: (Numbers in RED are Duty Task Headings listed below)

1.1.11 Learning to Read Independently
(100 – 1400, MSP, ASP)
E. Expand a reading vocabulary by identifying and correctly using idioms and words with literal and figurative meanings. Use a dictionary or related reference.
F. Understand the meaning of and apply key vocabulary across the various subject areas.

1.2.11 Reading Critically in All Content Areas
(100 – 1400, MSP, ASP)
A. Read and understand essential content of informational texts and documents in all academic areas.
B. Use and understand a variety of media and evaluate the quality of material produced.

1.5.11 Quality of Writing
(500, 600, 1300, 1400, MSP, ASP)
F. Edit writing using the conventions of language.

1.6.11 Speaking and Listening
(100 – 1400, MSP, ASP)
A. Listen to others.
D. Contribute to discussions.
E. Small and large group discussion.

1.8.11 Research
(200, 1000, 1100, 1200, 1400, MSP, ASP)
A. Select and refine a topic for research.
B. Locate information using appropriate sources and strategies.
C. Organize, summarize and present the main ideas from research.

2.1.11 Numbers, Number Systems and Number Relationships
(300, 400, 700-1400, MSP, ASP)
A. Use operations (e.g., opposite, reciprocal, absolute value, raising to a power, finding roots, finding logarithms).

2.2.11 Computation and Estimation
(300, 400, 700-1400, MSP, ASP)
A. Develop and use computation concepts, operations and procedures with real numbers in problem-solving situations.
B. Use estimation to solve problems for which an exact answer is not needed.
D. Describe and explain the amount of error that may exist in a computation using estimates.
E. Recognize that the degree of precision needed in calculating a number depends on how the results will be used and the instruments used to generate the measure.
2.3.11 Measurement and Estimation
(300, 400, 700-1400, MSP, ASP)
A. Select and use appropriate units and tools to measure to the degree of accuracy required in particular measurement situations.
B. Measure and compare angles in degrees and radians.
C. Demonstrate the ability to produce measures with specified levels of precision.

2.5.11 Mathematical Problem Solving and Communication
(300, 400, 700-1400, MSP, ASP)
C. Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas and results.

2.8.11 Algebra and Functions
(700, 1000-1400, MSP, ASP)
N. Solve linear, quadratic and exponential equations both symbolically and graphically.
Q. Represent functional relationships in tables, charts and graphs.

2.9.11 Geometry
(300, 400, 700-1400, MSP, ASP)
E. Solve problems involving inscribed and circumscribed polygons.
F. Use the properties of angles, arcs, chords, tangents and secants to solve problems involving circles.

2.10.11 Trigonometry
(300, 400, 700-1400, MSP, ASP)
B. Identify, create and solve practical problems involving right triangles using the trigonometric functions and the Pythagorean Theorem.

2.11.11 Concepts of Calculus
(900)
A. Determine maximum and minimum values of a function over a specified interval.
B. Interpret maximum and minimum values in problem situations.

3.1.10 Unifying Themes
(300, 400, 700-1400, MSP, ASP)
A. Discriminate among the concepts of systems, subsystems, feedback and control in solving technological problems.
B. Describe concepts of models as a way to predict and understand science and technology.
D. Apply scale as a way of relating concepts and ideas to one another by some measure.

3.1.12 Unifying Themes
(300, 400, 700-1400, MSP, ASP)
A. Apply concepts of systems, subsystems, feedback and control to solve complex technological problems.
B. Apply concepts of models as a method to predict and understand science and technology.
D. Analyze scale as a way of relating concepts and ideas to one another by some measure.

3.2.10 Inquiry and Design
(300, 400, 700-1400, MSP, ASP)
B. Apply process knowledge and organize scientific and technological phenomena in varied ways.
D. Identify and apply the technological design process to solve problems.

3.2.12 Inquiry and Design
(300, 400, 700-1400, MSP, ASP)
B. Evaluate experimental information for appropriateness and adherence to relevant science processes.
D. Analyze and use the technological design process to solve problems.

3.7.10 Technological Devices
(300, 400, 700-1400, MSP, ASP)
A. Identify and safely use a variety of tools, basic machines, materials and techniques to solve problems and answer questions.
B. Apply appropriate instruments and apparatus to examine a variety of objects and processes.
C. Apply basic computer operations and concepts.
D. Utilize computer software to solve specific problems.

3.7.12 Technological Devices
(300, 400, 700-1400, MSP, ASP)
A. Apply advanced tools, materials and techniques to answer complex questions.
B. Evaluate appropriate instruments and apparatus to accurately measure materials and processes.
C. Evaluate computer operations and concepts as to their effectiveness to solve specific problems.
D. Evaluate the effectiveness of computer software to solve specific problems.
13.1.11 Career Awareness and Preparation
(100-1400, MSP, ASP)
B. Analyze career options based on personal interests, abilities, aptitudes, achievements, and goals
C. Analyze how the changing roles of individuals in the workplace relate to new opportunities within career choices.
F. Analyze the relationship between career choices and career preparation opportunities (degrees)
G. Assess the implementation of the individualized career plan through the development of a career portfolio.

13.2.11 Career Acquisition
(100-1400, MSP, ASP)
A. Apply effective speaking and listing skills used in a job interview
C. Develop and assemble career acquisition documents. (job application, resume)
D. Analyze, revise, and apply an individualized career portfolio to chosen career path
E. Demonstrate essential workplace skills / knowledge such as commitment, dependability, and technology

13.3.11 Career Retention and Advancement
(100-1400, MSP, ASP)
E. Evaluate time management strategies and their application to both personal and work situations.
G. Evaluate the impact of lifelong learning on career retention and advancement.

Anchors

R11.A.2.1.1 (100-1400, MSP, ASP) Identify and/or apply meaning of multiple-meaning words used in text.
R11.A.2.1.2 (100-1400, MSP, ASP) Identify and/or apply meaning of content-specific words used in text.
R11.A.2.2.1 (100-1400, MSP, ASP) Identify and apply how the meaning of a word is changed when an affix is added; identify the meaning of a word from the text with an affix.
R11.A.2.2.2 (100-1400, MSP, ASP) Define and/or apply how the meaning of words or phrases changes when using context clues given in explanatory sentences.
R11.A.2.3.1 (100-1400, MSP, ASP) Make inferences and/or draw conclusions based on information from text.
R11.A.2.4.1 (100-1400, MSP, ASP) Identify and/or explain stated or implied main ideas and relevant supporting details from text.
R11.A.2.5.1 (100-1400, MSP, ASP) Summarize the major points, processes, and/or events of a nonfictional text as a whole.
R11.B.3.3.1 (100-1400, MSP, ASP) Explain, interpret, and/or analyze the effect of text organization, including the use of headers.
R11.B.3.3.4 (100-1400, MSP, ASP) Identify, explain, compare, interpret, describe, and/or analyze the sequence of steps in a list of directions.
M11.A.2.1.1 (700) Solve problems using operations with rational numbers including rates and percents (single and multi-step and multiple procedure operations) (e.g., distance, work and mixture problems, etc.).
M11.A.2.1.2 (400, 700, 1300) Solve problems using direct and inverse proportions.
M11.A.2.1.3 (400, 700, 1300) Identify and/or use proportional relationships in problem solving settings.
M11.A.3.2.1 (400) Use estimation to solve problems.
M11.B.2.1.1 (300, 400, 600, 700, 800, 1100) Measure and/or compare angles in degrees (up to 360°) (protractor must be provided or drawn).
M11.B.2.2.1 (400) Calculate the surface area of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet.
M11.B.2.2.2 (700) Calculate the volume of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet.
M11.B.2.2.3 (700) Estimate area, perimeter or circumference of an irregular figure.
M11.B.2.2.4 (700, 800, 1000) Find the measurement of a missing length given the perimeter, circumference, area or volume.
M11.B.2.3.1 (400, 700, 800, 900, 1000) Describe how a change in the linear dimension of a figure affects its perimeter, circumference, area or volume.
M11.C.1.1.1  (800, 900, 1000) Identify and/or use the properties of a radius, diameter and/or tangent of a circle (given numbers should be whole.)

M11.C.1.1.2  (900, 1000) Identify and/or use the properties of arcs, semicircles, inscribed angles and/or central angles.

M11.C.1.2.1  (800, 900) Identify and/or use properties of triangles (e.g., medians, altitudes, angle bisectors, side/angle relationships, Triangle Inequality Theorem).

M11.C.1.2.3  (800) Identify and/or use properties of isosceles and equilateral triangles

M11.C.1.3.1  (400) Identify and/or use properties of congruent and similar polygons or solids.

M11.C.1.4.1  (400, 1000) Find the measure of a side of a right triangle using the Pythagorean Theorem (Pythagorean Theorem included on the reference sheet).

M11.D.2.2.3  (900) Simplify algebraic fractions.

S11.A.1.1.4  (400, 600, 700) Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton’s universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur’s germ theory, relativity, heliocentric theory, ideal gas laws).

S11.A.1.2.2  (600, 700, 1100) Use case studies (e.g., Wright brothers’ flying machine, Tacoma Narrows Bridge, Henry Petroski’s Design Paradigms) to propose possible solutions and analyze economic and environmental implications of solutions for real-world problems.

S11.A.2.1.1  (600, 1000) Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.

S11.A.2.1.2  Critique the elements of the design process (e.g., identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.

S11.A.2.1.5  (800) Communicate results of investigations using multiple representations.

S11.A.2.2.1  (300, 400, 900, 1000, 1100, 1300) Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).

S11.A.2.2.2  (300, 400, 700, 900, 1000, 1100, 1300) Explain how technology (e.g., GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.

S11.A.3.1.1  (1200) Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.

S11.A.3.1.2  (900) Analyze and predict the effect of making a change in one part of a system on the system as a whole.

S11.A.3.2.2  (400, 1300) Describe advantages and disadvantages of using models to simulate processes and outcomes.

S11.A.3.3.2  (600, 800, 900, 1000, 1100, 1200, 1300) Compare stationary physical patterns (e.g., crystals, layers of rocks, skeletal systems, tree rings, atomic structure) to the object’s properties.

S11.A.3.3.3  (600) Analyze physical patterns of motion to make predictions or draw conclusions (e.g., solar system, tectonic plates, weather systems, atomic motion, waves).

S11.C.1.1.2  (600) Explain the relationship between the physical properties of a substance and its molecular or atomic structure

S11.C.3.1.3  (800) Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).
WCSD Academic Standards: (List or None)

Aligned with PA Standards

Industry or Other Standards:

American National Standards Institute (ANSI)
American Society of Mechanical Engineers (ASME)
International Organization for Standardization (ISO)

SPECIAL EDUCATION AND GIFTED REQUIREMENTS

The teacher shall make appropriate modifications to instruction and assessment based on a student’s Individual Education Plan (IEP) or Gifted Individual Education Plan (GIEP).

SPECIFIC EDUCATIONAL OBJECTIVES/CORRESPONDING STANDARDS AND ELIGIBLE CONTENT WHERE APPLICABLE
(List Objectives, PA Standards #'s, Other Standards (see samples at end))

See “Standards” and “Anchors” above.

ASSESSMENTS

PSSA Assessment Anchors Addressed: The teacher must be knowledgeable of the PDE Assessment Anchors and/or Eligible Content and incorporate them into this planned instruction. Current assessment anchors can be found at pde@state.pa.us.

Formative Assessments: The teacher will develop and use standards-based assessments throughout the course.

Portfolio Assessment: Yes No

District-wide Final Examination Required: Yes No

Course Challenge Assessment:
1. Instructor approved Portfolio
2. Advanced grade on General Drafting NOCTI Written Exam
3. Advanced grade on General Drafting NOCTI Performance Exam

REQUIRED COURSE SEQUENCE AND TIMELINE
(Content must be tied to objectives)

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<td>1400 PERFORMING SUPPLEMENTAL DRAFTING ACTIVITIES</td>
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Objectives: (Sample Competency List)

**Competency Assessment for Career & Technical Pre-Engineering Program**

**H** - Highly skilled, able to work independently  
**M** - Moderately skilled, requires minimum supervision  
**L** - Limited skills, requires full supervision  
**N** – Not applicable  

### 100 ORIENTATION

101 Demonstrate safety in the drafting room.  
102 Demonstrate professionalism.  

### 200 CAREER AWARENESS AND EMPLOYABILITY

201 Perform career exploration.  
202 Identify Local and National Career opportunities.  

### 300 APPLICATION OF INSTRUMENTS

301 Demonstrate use of basic board drafting tools and equipment.  
302 Demonstrate equipment usage by producing a one-view drawing using scaled measurements.  
303 Demonstrate basic uses of scales.  

### 400 GEOMETRIC CONSTRUCTION

401 Draw to scale.  
402 Draw a series of geometric figures.  
403 Demonstrate geometric construction principals.  
404 Create drawings using Geometric Construction principles.  

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Objectives: (Sample Competency List)
500 LETTERING

501 Letter and numbers in single stroke capital letters (Gothic).  H M L N
502 Draw, modify and apply text justifications on a CAD system.  H M L N

600 FREEHAND DRAWING AND SKETCHING

601 Sketch the alphabet of lines.  H M L N
602 Sketch orthographic views.  H M L N
603 Sketch an oblique and isometric drawing.  H M L N
604 Develop a pictorial using freehand methods.  H M L N
605 Explain the importance of freehand sketching.  H M L N
606 Letter clear, neat freehand notes and dimensions on a technical sketch.  H M L N
607 Describe and imply design intent as related to the sketching process.  H M L N

700 ENGINEERING MATH

701 Use basic engineering math operations to demonstrate scaling techniques.  H M L N
702 Use basic engineering math to solve engineering problems.  H M L N
703 Construct lines on a CAD system using relative, absolute and polar coordinate systems.  H M L N
704 Establish the relationship among points, lines, and planes in 3-D space.  H M L N
705 Solve descriptive geometry problems.  H M L N

800 INTRODUCTION TO MECHANICAL

801 Identify & draw necessary orthographic views.  H M L N
802 Explain the relationship of orthographic projection to multiview drawing.  H M L N
803 Demonstrate knowledge of 3rd angle projection.  H M L N
804 Identify & draw auxiliary views.  H M L N
805 Identify & draw section views.  H M L N
806 Identify & draw patterns and developments.  H M L N
807 Identify & draw section views.  H M L N
808 Identify & draw threads and fasteners.  H M L N

900 DIMENSIONING

901 Apply measurements, notes, and symbols to a technical drawing.  H M L N
902 Apply ANSI Standards for Dimensions, tolerances, and notes.  H M L N
903 Apply ISO Standards for Dimensions and notes.  H M L N
904 Specify geometric tolerances using symbols and notes.  H M L N

1000 INTRODUCTION TO ARCHITECTURE

1001 Read and interpret blueprints.  H M L N
1002 Construct a floor plan.  H M L N
1003 Construct an elevation.  H M L N
1004 Construct a typical wall section.  H M L N

1100 INTRODUCTION TO CIVIL DRAFTING

1101 Construct a site plan.  H M L N
1102 Construct a of a profile view.  H M L N

1200 INTRODUCTION TO ELECTRICAL AND ELECTRONIC DRAFTING

1201 Identify and describe various symbols.  H M L N
1202 Create a schematic wiring diagram.  H M L N

1300 USING COMPUTER ASSISTED DRAFTING (CAD)
1301 Utilize input and output devices such as printers, plotters, etc.  
1302 Use drawing aids and controls.  
1303 Use drawing and editing tools.  
1304 Use viewing tools.  
1305 Utilize a commercially built drafting library.  
1306 Produce a custom built drafting library.  
1307 Make a revision to an existing drawing.  
1308 Configure and use dimensions and tolerances.  
1309 Create 3-dimensional drawings and models.  
1310 Create surface models.  
1311 Create parametric solid models.  
1312 Demonstrate rendering.  
1313 Demonstrate importing, exporting, and linking of drawings.  

**1400 PERFORMING SUPPLEMENTAL DRAFTING ACTIVITIES**

1401 Draw a cover sheet.  
1402 Prepare plan abbreviations list.  
1403 Add title block information to drawings.  
1404 Indicate on plans the location of section views.  
1405 Make copies of original drawings.  
1406 File original working drawings.  

**MSP – MECHANICAL SENIOR PROJECT**

a. Senior will be responsible for providing their own mechanical project  
   which will include at least (10) ten different parts.  
b. Produce working sketches of all parts including caliper-based dimensions.  
c. Produce all detail drawings including all necessary views  
d. Produce bill of materials.  
   - part numbers  
   - part names  
   - part materials  
   - number required  
e. Produce sub assemblies.  
f. Produce main assembly  
g. Produce a sectioned assembly  

**ASP - Architectural Senior Project**

a. Senior will be responsible for designing a 2000-3000 square foot house.  
b. Produce plot plan.  
c. Produce working sketching of all floor plans including dimensions.  
d. Produce floor plans (all floors).  
e. Produce foundation plan.  
f. Produce elevations (north, south, east, west).  
g. Produce all necessary sections (wall and full structure).  
h. Produce door and window schedules (use standard windows and doors  
   from a catalog).  
i. Produce stair details.  
j. Produce isometric or 3-D model of house complete with doors, windows,  
   siding, and textures.  

**WRITING TEAM:**

Name: Dave Adams  
Position: Design Engineering Manager  
Company: Betts Industries
Name: Eric Amerine  
Position: Asst. Director of Petroleum Development  
Company: United Refining Co.

Name: Brad Church  
Position: Drafter / WCCC Co-op Student  
Company: United Refining Co.

Name: Jon Mechling  
Position: Director of Retail Maintenance  
Company: United Refining Co.

Name: Randy Mineweaser  
Position: Plant Manager  
Company: Loranger International Corp.

Name: Dan Passmore  
Position: Pre-Engineering Instructor  
Company: Warren County Career Center

Name: Donna Zariczny  
Position: Architect  
Company: Inscale Architects

Name: Jeffrey Zariczny  
Position: Architect  
Company: Inscale Architects

WCSD STUDENT DATA SYSTEM INFORMATION

1. Is there a required final examination?  
   ___ X ___ Yes  _____ No

2. Does this course issue a mark/grade for the report card?  
   ___ X ___ Yes  _____ No

3. Does this course issue a Pass/Fail mark?  
   _____ Yes  ___ X ___ No

4. Is the course mark/grade part of the GPA calculation?  
   ___ X ___ Yes  _____ No

5. Is the course eligible for Honor Roll calculation?  
   ___ X ___ Yes  _____ No

6. What is the academic weight of the course?  
   _____ No weight/Non credit  ___ X ___ Standard weight  
   _____ Enhanced weight (Describe)