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AUTHOR	Miller, Lavonna; Draeger, Meg; Bowermeister, Bob; Wancho, Richard
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ABSTRACT

This document, which lists engineering technologies competencies as identified by representatives from business and industry as well as secondary and post-secondary educators throughout Ohio, is intended to assist individuals and organizations in developing college tech prep programs that will prepare students from secondary through post-secondary associate degree programs for employment in three occupational cluster areas: design, process, and product/service. Each of the cluster areas contains essential competencies common to all occupations within them including engineering technology in society; creativity and inventive thinking; technical problem solving; design for engineering technology; managing engineering technology information; teamwork and project management; ethics in engineering technology; design documentation; data collection and analysis; workplace safety and environmental issues; quality; materials; electrical systems; and mechanical systems as well as those common to each of the occupations within the cluster and competencies specific to an occupation. The competencies, which are separated into essential competencies needed to ensure a minimal level of employability and recommended competencies, are organized by instructional units and include suggestions as to when students should be introduced to and proficient at them. Appendices include a list of resources, a pathway template, a list of technical competency profile panel members, and an illustration of the job market, which consists of information about relevant jobs advertised in the "Dayton Daily News" during the spring and summer of 2002. (MO)

OHIO
ENGINEERING TECHNOLOGIES
COMPETENCY PROFILE

Lavonna Miller
Project Director
College Tech Prep Curriculum Services
Center on Education and Training for Employment
The Ohio State University

Meg Draeger
Project Leader and Engineer
Sinclair Community College

Bob Bowermeister, Ph.D
Assistant Director
Industrial and Engineering Systems
Ohio Department of Education

Richard Wancho
Industrial and Engineering Systems Consultant
Ohio Department of Education

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INTRODUCTION

The Ohio Engineering Technologies Competency Profile was collaboratively developed by the Ohio Board of Regents and the Department of Education, Career Technical and Adult Education, and the Center on Education and Training for Employment at The Ohio State University. The profile provides a framework for a broad-based educational response to curricula for engineering technologies. The need for engineering technologists developed because of the need for graduates who have the ability to design, fabricate and test. Engineering technologists work best by the application of engineering principles.

The profile includes essential competencies that are grounded in engineering technology secondary through post secondary studies. The profile is further delineated by three occupational cluster areas: design, process, and product/service. Each of the cluster areas contains essential competencies common to each of the occupations within the cluster and competencies specific to an occupation. This profile design reflects programming flexibility that represents many options for educational studies and career planning.

Representatives from a broad spectrum of Ohio's professionals played a critical role in defining the vision and scope of engineering technologies and in defining the essential skills for current and future employees. Secondary and post-secondary educators representing Ohio schools and colleges identified essential competencies with proficiency standards met by the attainment of the Associate Degree. Ohio's Academic Standards are referenced to reflect higher academic course work in preparation for continued educational studies. (A list of business/industry representatives and educators participating in the development of the profile appears in the appendices.)

The Engineering Technologies Competency Profiles will be used as the basis for the development of an integrated delivery system that provides opportunities for new and challenging programs and courses. Career-Technical Education, College Tech Prep, and post secondary degree programs will be enhanced and expanded through the use of the Engineering Technologies curriculum. Samples of delivery models are referenced in the introductory section.

This profile is available on the Internet at: **www.ohtpcs.org**. At this location users can download copies of the entire profile or conduct searches on a number of key variables.

For additional information contact:

College Tech Prep Curriculum Services
The Ohio State University
1900 Kenny Road
Columbus, Ohio 43210
Phone: 614-292-8404

Industrial & Engineering Systems
Ohio Department of Education
25 South Front Street, Sixth Floor
Columbus, Ohio 43215
Phone: 614-466-2901

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Project Manager:	Lavonna F. Miller, Research Specialist College Tech Prep Curriculum Services The Ohio State University
Project Leader:	Meg Draeger, Engineer Sinclair Community College
Consultant:	Debbie Neal
Information Services:	Damian Brown, Systems Specialist College Tech Prep Curriculum Services The Ohio State University
Administrative Support:	Janet I. Ray, Office Production Assistant College Tech Prep Curriculum Services The Ohio State University

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COLLEGE TECH PREP

College Tech Prep is a high school and college career path linked to business, industry, and labor that insures a specified seamless pathway from high school to college to careers, meeting Ohio's technological employment needs.

A College Tech Prep student is enrolled in a state approved Tech Prep education program. A College Tech Prep Program means a program of study that:

- Combines, at a minimum, two years of secondary education (as determined by Ohio definitions) with a minimum of two years of post-secondary education in a non-duplicative, sequential course of study.
- Integrates academic and technical instruction and utilizes work-based and work-site learning, where appropriate and available.
- Provides technical preparation in a career field such as engineering technology; applied science; mechanical, industrial or practical art or trade; agriculture; health occupations; business; or applied economics.
- Builds student competencies in mathematics, science, reading, writing, communications, economics, and workplace skills through applied, contextual academics and integrated instruction, in a coherent sequence of courses.
- Leads to an associate or baccalaureate degree, or a BAT (Bureau of Apprenticeship Training) apprenticeship requiring a minimum of two years in a specific career field.
- Leads to placement in appropriate employment or to further education.

Engineering vs. Engineering Technology

"Engineering technology is the profession in which knowledge of mathematics and natural sciences gained by higher education, experience, and practice is devoted primarily to the implementation and extension of existing technology for the benefit of humanity.

Engineering technology education focuses primarily on the applied aspects of science and engineering aimed at preparing graduates for practice in that portion of the technological spectrum closest to product improvement, industrial processes, and operational functions."

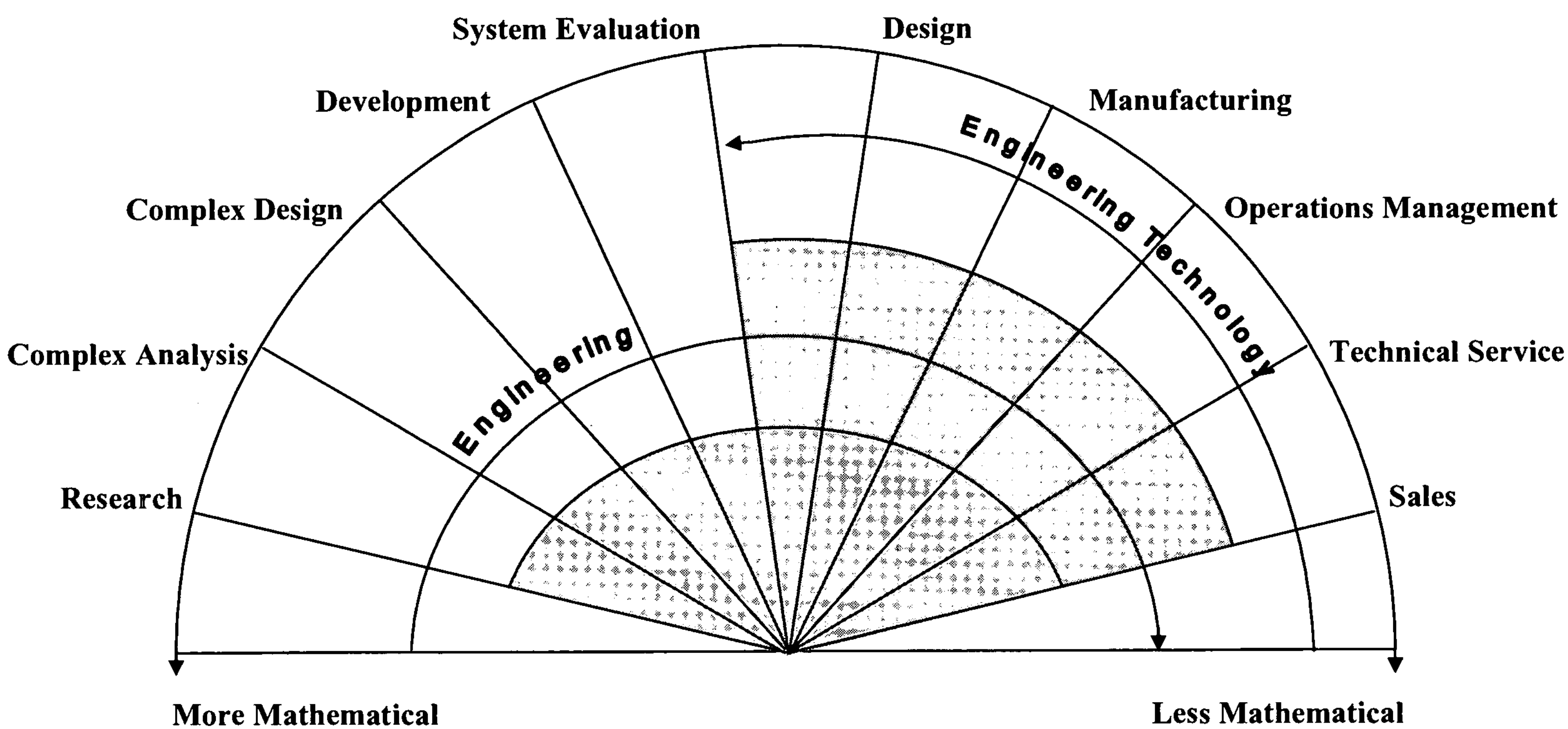
Definition of Engineering Technology
Adopted June 21, 1992
by the Engineering Technology Council of the American Society for Engineering Education

Where the greatest industry needs are:
Our futuring panel described a type of "middle person" in the engineering arena – someone above the level of a technician who can apply knowledge, and troubleshoot and refine a process or operation – an engineering technologist. This perspective particularly applies in the manufacturing industry. Rapidly changing technology necessitates the engineering technologist to remain current in knowledge of relevant applications.

The trend across industries, in the engineering world, is toward teamwork in which multiple engineering and engineering technology disciplines work together to solve problems; hence, the need for an engineering technologist to be more of a generalist, able to understand a little bit about a lot of areas. Some key skills required: trend analysis, research skills, where to find answers, and problem solving (esp. in teams) and critical thinking.

Engineering Technology	Engineering
Application and Design	Research, Theory and Design
Programming	
Troubleshooting	
Math knowledge includes algebra, trigonometry, analytic geometry, and the fundamentals of calculus with an emphasis on applications	Math knowledge includes algebra, trigonometry, analytic geometry, and calculus through differential equations with an emphasis on fundamental principles
Understands application techniques	Understands derivation of techniques
Application of principles	Understanding of theory behind principles
Options for higher degrees	Options for higher degrees

Engineering vs.
Engineering Technology



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Engineering Technologies Tech Prep Program
General Characteristics

Program is designed to
- provide a broad survey of multiple engineering technology fields at the secondary level,
- introduce common elements of engineering technologies at the secondary level, and reinforce throughout secondary and post-secondary levels,
- introduce technical competencies in at least one engineering technology cluster at the secondary level,
- prepare the student for advanced studies in a specific engineering technology field at the post-secondary level, and
- reinforce common elements and introduce more advanced skills in a specific engineering technology field at the post-secondary level.

Curriculum includes academic coursework in language arts, mathematics, sciences, social studies, foreign language, and technology taught to contextually coincide with an engineering technology framework.

Curriculum is delivered using integrated, contextual, hands-on methodology, and incorporates the scientific method, and an engineering design model of investigation, problem-solving, experimentation, and feedback.

Curriculum is enhanced by work-based learning, industry-based standards and credentials, program accreditation, and teacher credentials, and should include:
- student internships
- job shadowing
- mentorships
- industry field trips
- industry guest speakers in classroom
- college lab experiences
- "constructivist" contest/competition opportunities
- industry project work
- a 12th grade capstone project

Curriculum is supported and validated, and may be supplemented by industry-relevant standards including:
- National Academy of Sciences
- National Council of Teachers of Mathematics (NCTM)
- International Technology Education Association (ITEA)
- Manufacturing Skill Standards Council (MSSC)

Instructors in the Engineering Technologies Tech Prep program will engage in relevant continuing professional development and curriculum enhancement including:
- industry job shadowing
- industry externships
- active industrial advisory committee involvement

High school math courses (algebra, geometry, trigonometry, and pre-calculus), the physical sciences (chemistry, physics, and earth and space systems), communications (English, reading, writing), work ethics, professionalism and career planning, and basic computer applications are a part of the entire Tech Prep Engineering Technologies program curriculum, as referenced in academic and career planning/counseling content for program

The objective of clustering the engineering technology fields for the Tech Prep program implementation is to provide a structured approach for student exposure to multiple disciplines. Major fields of the engineering technology profession, as well as common designations for college level majors are grouped into clusters of similarity. The engineering technology profession crosses many industries. The curriculum needs to be supported by contextual references and examples across industries (e.g., automotive, aerospace, health care, manufacturing, transportation, construction).

KEY TO PROFILE CODES

Importance of Competencies

All of the competencies in this document represent the minimum requirements for a College Tech Prep engineering technologies program. It is the responsibility of the local consortia to further define and/or expand the key indicators for each competency, as needed. Each competency will be taught at either the introductory or proficiency level by the completion of the Tech Prep program, which is the minimum of an Associate Degree.

The intent of this document is to integrate high academics with skill acquisition. Technical skills are a required component. However, the degree of skill acquisition may vary based on the educational setting.

I = **Introduce** (Learner will demonstrate knowledge and comprehension of the competency.)

P = **Proficient** (Learner will demonstrate ability to apply knowledge of and/or perform the competency.)

Grade Level: **12** = by the end of grade 12
AD = by the end of the Associate Degree

All essential competencies have been assigned a P (Proficient) by end of the Associate Degree. [There may be instances where both Introduce and Proficient are at either the 12th grade or the Associate Degree.]

Academic Connection (AC)

All Tech Prep programs are responsible for meeting the academic content standards that are referenced in the appendix of this document.

Example:

BIL: Essential

EDU:	12	AD
	I	P

Competency 1.1: Analyze . . . .
Key Competency Indicators:
Explain . . . .
Identify . . . .

EXAMPLE:

Business, Industry, & Labor Panel

Competency is essential.

Competency should be introduced by end of 12th grade with proficiency achieved by the end of the associate degree.

BIL: Essential

Educator Panel

EDU:	12	AD
	1	P

Unit number

Competency 1.1: **Explain the relationship within the engineering and engineering technology profession**

Key Competency Indicators:

1.1.1 Differentiate among the objectives and functions of technology, science, engineering, and engineering technology

1.1.2 Identify examples of real world applications and innovations in the realm of engineering and technology

1.1.3 Identify tangible outcomes of engineering and engineering technology in society

Competency number

Indicator number

Competency indicators to be introduced prior to the end of the 12th grade.

ENGINEERING TECHNOLOGIES
COMPETENCY PROFILE OUTLINE

Units 1 – 14 are required essential competencies for any cluster (secondary through postsecondary)

1 Engineering Technology in Society 1
2 Creativity and Inventive Thinking 3
3 Technical Problem Solving 5
4 Design for Engineering Technology 7
5 Managing Engineering Technology Information 9
6 Teamwork and Project Management 11
7 Ethics in Engineering Technology 15
8 Design Documentation 17
9 Data Collection and Analysis 23
10 Workplace Safety and Environmental Issues 27
11 Quality 29
12 Materials 31
13 Electrical Systems 35
14 Mechanical Systems 37

15 Engineering Technology Design Cluster 41
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- 15A Civil Engineering Technology 45
- 15B Architectural Engineering Technology 49
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16 Engineering Technology Process Cluster 55
- 16 Process Cluster 57
- 16A Electrical Engineering Technology 59
- 16B Electronic Engineering Technology 61
- 16C Electromechanical Engineering Technology 63
- 16D Mechanical Engineering Technology 65

17 Engineering Technology Product/Service Cluster 67
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- 17A Industrial Engineering Technology 71
- 17B Manufacturing Engineering Technology 73
- 17C Quality Engineering Technology 75

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Engineering Technologies Program Sample Delivery Models

Example 1:	
Grades 11-14:	Units 1-14 – Secondary through Post-secondary Studies
Secondary:	Unit 15 Design Cluster – Essential Cluster Competencies plus Focus on one, two, or three Design Cluster specialty areas (i.e., Civil, Architectural, and Industrial Design), Survey additional programs available at post-secondary institutions within local Consortium, and 12th grade capstone project in Design Cluster (results primarily in exposure of entire class to a single cluster - Design)
Post-secondary:	Specialization in chosen Engineering Technology program

Example 2:	
Grade 11-14:	Units 1-14 – Secondary through Post-secondary Studies
Secondary:	Unit 16 Process Cluster – Essential Cluster Competencies plus Focus on one, two, three, or four Process Cluster specialty areas (i.e., Electrical, Electronics, Electromechanical/Automation and Control, and Mechanical), Survey additional programs available at postsecondary institutions within local Consortium, and 12th grade capstone project in Process Cluster (results primarily in exposure of entire class to a single cluster - Process)
Post-secondary:	Specialization in chosen Engineering Technology program

Example 3:	
Grade 11-14:	Units 1-14 – Secondary through Post-secondary Studies
Secondary:	Unit 17 Product/Service Cluster – Essential Cluster Competencies plus Focus on one, two, or three Product/Service Cluster specialty areas (i.e., Industrial & Systems, Manufacturing, and Quality), Survey additional programs available at postsecondary institutions within local Consortium, and 12th grade capstone project in Product/Service Cluster (results primarily in exposure of entire class to a single cluster – Product/Service)
Post-secondary:	Specialization in chosen Engineering Technology program

Example 4:	
Grade 11-14:	Units 1-14 – Secondary through Post-secondary Studies
Secondary:	Survey of all three (3) clusters via team assignment/research, job shadowing/internship, and project-based learning, and 12th grade capstone project in team's assigned cluster or specialty area (results in exposure of entire class to all clusters – Design, Process, and Product/Service)
Post-secondary:	Specialization in chosen Engineering Technology program

Engineering Technologies Program Example Delivery Models (Continued)

<u>Example 5:</u>

Grade 11-14:	Units 1-14 – Secondary through Post-secondary Studies
Secondary:	Unit 15 Design Cluster Essential Competencies and One specialty area under the Design Cluster (e.g., Civil), and 12th grade capstone project in Engineering Technology area of choosing
Post-secondary:	Specialization in chosen Engineering Technology program

<u>Example 6</u>

Grade 11-14:	Units 1-14 – Secondary through Post-secondary Studies
Secondary:	Unit 16 Process Cluster Essential Competencies and One specialty area under the Process Cluster (e.g., Electronics), and 12th grade capstone project in Engineering Technology area of choosing
Post-secondary:	Specialization in chosen Engineering Technology program

<u>Example 7</u>

Grade 11-14:	Units 1-14 – Secondary through Post-secondary Studies
Secondary:	Unit 17 Product/Service Cluster Essential Competencies and One specialty area under the Product/Service Cluster (e.g., Manufacturing), and 12th grade capstone project in Engineering Technology area of choosing
Post-secondary:	Specialization in chosen Engineering Technology program

Unit 1: Engineering Technology in Society

BIL: **Essential**

EDU:	12	AD
	I/P	P

Competency 1.1: **Explain the relationships within engineering technology**

Key Competency Indicators:

1.1.1 Differentiate among the objectives and functions of technology, science, engineering, and engineering technology

1.1.2 Identify examples of real world applications and innovations in the realm of engineering and technology

1.1.3 Identify tangible outcomes of engineering and technology in society

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 1.2 **Explain the personal and professional development requirements of pursuing an engineering technology career**

Key Competency Indicators:

1.2.1 Demonstrate study skills, discipline, and attitude required in pursuit of an engineering technology education and career

1.2.2 Identify potential educational pathways toward receiving an engineering technology education

1.2.3 Identify certification and licensing options available in engineering technology

1.2.4 Identify relevant engineering and technical professional associations and organizations that represent and promote engineering and engineering technology (e.g., American Academy of Environmental Engineers, American Ceramic Society, American Institute of Chemical Engineers, American Society of Civil Engineers, American Society of Heating, Refrigerating, and Air -Conditioning Engineers, American Society of Mechanical Engineers, American Society of Safety Engineers, Fluid Power Society, Institute of Electrical and Electronics Engineers, Institute of Industrial Engineers, Institute of Transportation Engineers, National Association of Radio and Telecommunications Engineers, Society for Materials Engineering International, Society of Automotive Engineers, Society of Manufacturing Engineers, Society of Plastics Engineers)

1.2.5 Begin planning for lifelong learning in engineering technology

1.2.6 Create and maintain a professional portfolio

BIL: Essential

EDU:	12	AD
	I	P

Competency 1.3 Explain engineering technology as a people-serving profession and its role in serving society

Key Competency Indicators:

1.3.1 Differentiate between examples of engineering technology applications and careers in manufacturing or product industries vs. service industries

1.3.2 Differentiate between examples of engineering technology applications and careers in profit vs. non-profit organizations

1.3.3 Demonstrate an awareness, and identify examples, of the leadership roles of engineering technologists

1.3.4 Demonstrate an awareness, and identify examples, of diversity issues as they are evidenced in engineering technology – women, minorities, and under-represented populations

1.3.5 Identify relevant professional associations and organizations that represent and support diversity in engineering technology (e.g., National Society of Black Engineers, Society of Hispanic Professional Engineers, Society of Women Engineers)

1.3.6 Demonstrate an awareness of the impact of government regulations and business and industry procedures on the performance and functions of engineering technologists

Unit 2: Creativity and Inventive Thinking

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 2.1: **Understand the applications of creative thinking in engineering technology**

Key Competency Indicators:

2.1.1 Research engineering achievements and innovations of the 20th century
2.1.2 Identify examples of creativity in everyday life
2.1.3 Understand the concepts of vision, paradigms, paradigm shifts, and out-of-the-box thinking

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 2.2: **Recognize formal means by which to protect creativity**

Key Competency Indicators:

2.2.1 Understand the basics of the patent process
2.2.2 Understand the ramifications of licenses, trademarks and copyrights
2.2.3 Understand the concept of intellectual property and proprietary material

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 2.3: **Demonstrate creative and inventive thinking as a member of an inventive thinking project team**

Key Competency Indicators:

2.3.1 Brainstorm ideas
2.3.2 Evaluate alternative ideas according to multiple criteria
2.3.3 Refine and develop an invention from best alternatives
2.3.4 Utilize various graphic organizer techniques (e.g., Venn diagrams, fishbone diagrams, cause-and-effect diagrams)

Unit 3: Technical Problem Solving

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 3.1: **Demonstrate systems thinking skills**

Key Competency Indicators:

3.1.1 Identify the system involved in a given problem (e.g., purpose, boundaries, components, variables, constraints)
3.1.2 Recognize the "big picture" of a situation or problem
3.1.3 Demonstrate consideration of the impact of decisions on individual components of a system as well as on the system as a whole
3.1.4 Model a situation or problem descriptively and/or pictorially
3.1.5 Understand the application of the scientific method

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 3.2: **Demonstrate a systematic process in solving a problem**

Key Competency Indicators:

3.2.1 Define the problem
3.2.2 Extract relevant information from that given
3.2.3 Gather additional information as needed through research, observation, and data collection
3.2.4 Generate alternative solutions (use mathematical or scientific model or formula, if applicable)
3.2.5 Analyze feasibility of alternative solutions (e.g., pros, cons, benefits, costs)
3.2.6 Iteratively select and refine the best solution
3.2.7 Recommend, communicate, and defend solution

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 3.3: **Demonstrate timely decision-making skills**

Key Competency Indicators:

3.3.1 Identify the urgency, if any, of addressing a given problem or situation; recognize the allotted time
3.3.2 Demonstrate critical thinking in addressing a problem or situation
3.3.3 Produce a viable solution for a problem in the allotted time

Unit 4: Design for Engineering Technology

BIL: Essential

EDU:	12	AD
	I	P

Competency 4.1: Demonstrate an understanding of the design process

Key Competency Indicators:

4.1.1 Define a process (input, transformation, output)
4.1.2 Describe the design process (customer needs, concept, specifications, prototype, testing, production)
4.1.3 Describe the relationship between design and manufacturing
4.1.4 Describe the application of process design in industries other than manufacturing (designing a service rather than a product)

BIL: Essential

EDU:	12	AD
	I	P

Competency 4.2: Research, develop, and produce a product

Key Competency Indicators:

4.2.1 Identify a customer need/constraints for a product
4.2.2 Research existing products
4.2.3 Conceptualize products to meet the need
4.2.4 Define product specifications to meet the need
4.2.5 Design the product; create technical drawings and documentation
4.2.6 Determine and document a process by which to produce the product
4.2.7 Identify and obtain the resources required to produce a specific product
4.2.8 Determine the production cost of the product (materials, labor, equipment)
4.2.9 Produce a prototype of the product
4.2.10 Test the prototype against specifications
4.2.11 Refine the production process according to the test outcome

4.2.12 Produce the product in desired quantity
4.2.13 Present the product features and specifications in oral, written, and visual form

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 4.3: **Research, develop, and provide a service**

Key Competency Indicators:
4.3.1 Identify a customer need/constraints for a service
4.3.2 Research existing services
4.3.3 Conceptualize services to meet the need
4.3.4 Define service specifications to meet the need
4.3.5 Design the service; create technical documentation
4.3.6 Determine and document a process by which to provide the service
4.3.7 Identify and obtain the resources required to deliver a specific service
4.3.8 Determine the cost of providing the service (space, materials, labor, equipment)
4.3.9 Produce a prototype of the service
4.3.10 Test the prototype against specifications
4.3.11 Refine the service according to the test outcome
4.3.12 Deliver the service in desired quantity
4.3.13 Present the service features and specifications in oral, written, and visual form

Unit 5: Managing Engineering Technology Information

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 5.1: **Demonstrate effective engineering technology research skills**

Key Competency Indicators:

5.1.1 Identify common engineering-related references, information sources, and resource materials
5.1.2 Identify Internet search tools and techniques best for engineering technology research
5.1.3 Select reference materials to research a specific engineering technology problem, topic, or situation
5.1.4 Extract relevant information from reference materials
5.1.5 Demonstrate an ability to read and understand technical documentation and resource materials
5.1.6 Demonstrate an ability to interpret and explain (oral and written) technical information in commonly understood terms

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 5.2: **Communicate findings of research in an engineering technology area**

Key Competency Indicators:

5.2.1 Synthesize research findings
5.2.2 Formulate salient summary statements of research findings
5.2.3 Prepare a concise summary presentation (written and oral)
5.2.4 Deliver a summary presentation

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 5.3: **Maintain a journal to document progress during an engineering technology project**

Key Competency Indicators:

5.3.1 Demonstrate effective note-taking skills during individual and team work sessions

5.3.2 Demonstrate ability to communicate status of a project by referencing journal

5.3.3 Incorporate completed project notes and learning as appropriate in subsequent projects

Unit 6: Teamwork and Project Management

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 6.1: **Demonstrate teamwork skills as a technical member of a cross-functional project team**

Key Competency Indicators:

6.1.1 Interact effectively with technical and non-technical team members
6.1.2 Participate appropriately in team meetings
6.1.3 Complete assigned responsibilities in timely, acceptable manner so as to ensure progress of the team

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 6.2: **Demonstrate an understanding of organization and project structure**

Key Competency Indicators:

6.2.1 Distinguish among project purpose, goals, objectives, priorities, tasks
6.2.2 Distinguish among multiple project management and reporting structures (e.g., hierarchy, partnerships, collaboration, expert consultant, self-direction)

BIL: Essential

EDU:	12	AD
	I	P

Competency 6.3: Demonstrate effective project management techniques

Key Competency Indicators:

6.3.1 Understand and value the roles of various team members

6.3.2 Utilize appropriate facilitation skills in conducting team meetings

6.3.3 Develop and monitor a project work plan, task outline, timeline, resource allocation, cost estimation, and team roles and responsibilities (e.g., use manual Gantt chart documentation and project management software application)

6.3.4 Identify common project scheduling techniques (e.g., critical path methodology (CPM), Project Evaluation and Review Technique (PERT)) and their ramifications on project completion

6.3.5 Demonstrate appropriate progress monitoring techniques (e.g., communication, observation, worksite inspection, critical task identification)

6.3.6 Conduct contingency planning as required for a project

6.3.7 Prepare and communicate project status reports to supervisor and stakeholders outside the team

6.3.8 Evaluate project outcome upon completion of a project

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 6.4: **Demonstrate an understanding of the basics of engineering economic analysis**

Key Competency Indicators:

6.4.1 Compare make vs. buy, and lease vs. buy decisions
6.4.2 Identify alternative project solutions using defined criteria
6.4.3 Apply the concept of probability of occurrence in evaluating alternatives
6.4.4 Understand the impact of the time value of money on decision-making
6.4.5 Understand the impact of forecasting on decision-making

Unit 7: Ethics in Engineering Technology

BIL: Essential

EDU:	12	AD
	I	P

Competency 7.1: Demonstrate an understanding of the concept of ethics

Key Competency Indicators:

7.1.1 Identify examples of unethical behavior (e.g., plagiarism, copyright–, software-, and patent infringement, cheating, breach of confidentiality, solicitation)
7.1.2 Define ethics as applicable for a worker and leader in the engineering profession
7.1.3 Differentiate between "ethical" and "legal"
7.1.4 Differentiate between "honesty" and "loyalty"
7.1.5 Understand the basics of law as it relates to engineering technology
7.1.6 Understand the implications of product or service quality, warranty, and reliability

BIL: Essential

EDU:	12	AD
	I	P

Competency 7.2: Describe ethical conduct in various work settings

Key Competency Indicators:

7.2.1 Identify appropriate relationships and conduct between technical professionals in competitor organizations
7.2.2 Identify appropriate relationships and conduct of a technical professional with suppliers and clients or customers
7.2.3 Identify appropriate conduct of a technical professional in relation to the public

7.2.4 Understand the concept of a "corporate culture" and its ramifications for an employee's behavior
7.2.5 Identify appropriate methods of conflict resolution

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 7.3: **Demonstrate ethical and professional behavior**

Key Competency Indicators:
7.3.1 Conduct appropriate relations with peers, fellow workers, and supervisors or instructors
7.3.2 Complete assignments in a timely, quality manner
7.3.3 Maintain an appropriate appearance and attitude in academic or work environment and personal interactions
7.3.4 Participate in professional development, social and/or service efforts sponsored by engineering and technical professional organizations

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 7.4: **Demonstrate an awareness of ethics in society**

Key Competency Indicators:
7.4.1 Identify environmental, educational, work/family, and societal issues in current events as they relate to technological development
7.4.2 Identify a sampling of organizations or agencies that address such issues
7.4.3 Recognize examples of proper and ethical utilization of a chain of command to communicate issues and promote societal benefit

Unit 8: Design Documentation

BIL: **Essential**

EDU:	12	AD
	P	P

Competency 8.1: **Demonstrate appropriate knowledge and use of drafting tools and equipment**

Key Competency Indicators:

8.1.1 Select proper equipment to complete a given project (measuring scales, drawing media, drafting instruments, consumable materials)
8.1.2 Demonstrate effective use of standard equipment
8.1.3 Demonstrate safe and proper care and storage of equipment

BIL: **Essential**

EDU:	12	AD
	P	P

Competency 8.2: **Demonstrate basic drafting skills**

Key Competency Indicators:

8.2.1 Define and interpret drawing scale
8.2.2 Select proper drawing scale for given projects
8.2.3 Identify line styles, types, and weights, and their use
8.2.4 Apply appropriate freehand and lettering techniques
8.2.5 Create title blocks for given projects
8.2.6 Perform basic geometric construction of lines, angles, tangents, polygons, arcs, line, angle, and arc division, and circles
8.2.7 Prepare multi-view freehand sketches
8.2.8 Prepare single view drawings
8.2.9 Prepare multi-view drawings
8.2.10 Prepare orthographic views
8.2.11 Prepare change control/revision blocks for drawings

BIL: **Essential**

	12	AD
EDU:	P	P

Competency 8.3: **Demonstrate intermediate drafting skills**

Key Competency Indicators:

8.3.1 Prepare isometric, oblique, and perspective sketches
8.3.2 Prepare auxiliary and sectional views
8.3.3 Identify and use various symbols and annotation methods per ANSI standards (e.g., general notes, keynotes, revisions)

BIL: **Essential**

	12	AD
EDU:	P	P

Competency 8.4: **Interpret basic prints**

Key Competency Indicators:

8.4.1 Visualize and describe objects from drawings
8.4.2 Interpret orthographic projections
8.4.3 Interpret isometric and sectional views
8.4.4 Interpret detail and assembly drawings
8.4.5 Interpret dimensions from a drawing

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 8.5: **Demonstrate basic dimensioning skills**

8.5.1 Select from and convert among dimensioning systems (i.e., English fractional, English decimal, or metric)
8.5.2 Select and construct appropriate dimensioning symbols (e.g., arrowheads, text, extension lines, surface and texture)
8.5.3 Dimension drawings according to ANSI standards

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 8.6: **Differentiate among various types of engineering drawings and blueprints**

Key Competency Indicators:
8.6.1 Recognize various detail drawings (e.g., part detail, assembly, electrical, pneumatic/hydraulic, mapping, civil, machine, cam and gear, architectural prints, plumbing and HVAC prints, and electrical and electronic prints)
8.6.2 Interpret various detail drawings (e.g., part detail, assembly, electrical, pneumatic/hydraulic, mapping, civil, machine, cam and gear, architectural prints, plumbing and HVAC prints, and electrical and electronic prints)

BIL: **Essential**

EDU:	12	AD
	P	P

Competency 8.7: **Demonstrate computer-aided drafting and design (CADD) system skills**

Key Competency Indicators:

8.7.1 Utilize multiple CADD input methods (e.g., electronic text file, keyboard, mouse, digitizer, scanner)

8.7.2 Utilize multiple CADD output devices (e.g., printer, plotter, electronic file transfer)

8.7.3 Demonstrate effective CADD file management (naming, storage, retrieval, back-up, transfer)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 8.8: **Demonstrate fundamental computer-aided drafting and design (CADD) skills**

Key Competency Indicators:

8.8.1 Demonstrate multiple drawing entity selection methods (e.g., single entity selection, window, crossing-box, fence, last, previous, by type, all)

8.8.2 Demonstrate effective use of drawing, blocks, templates, and layers

8.8.3 Demonstrate effective use of program functions and symbol libraries

8.8.4 Demonstrate accurate extraction of entity and drawing information (e.g., distances, locations, entity properties)

8.8.5 Create two-dimensional orthographic drawings with dimensions and annotations

BIL: Essential

EDU:	12	AD
	I	P

Competency 8.9: Demonstrate intermediate computer-aided drafting and design (CADD) skills

Key Competency Indicators:

8.9.1 Create isometric, oblique, and perspective drawings
8.9.2 Create auxiliary and sectional views
8.9.3 Demonstrate view control during a CADD working session

BIL: Essential

EDU:	12	AD
		I

Competency 8.10: Demonstrate advanced computer-aided drafting and design (CADD) skills

Key Competency Indicators:

8.10.1 Create three-dimensional CADD models
8.10.2 Create solid models

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 8.11: **Differentiate among various engineering-related documentation other than prints and drawings**

Key Competency Indicators:

8.11.1 Utilize various engineering-related documents (e.g., bills of materials, production routings, set-up, assembly and operational instructions, preventive maintenance procedures, material safety data sheets, process flow diagrams, engineering change control records, as-built drawings, and engineering specifications)

8.11.2 Interpret various engineering-related documents

8.11.3 Create various engineering-related documents

Unit 9: Data Collection and Analysis

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 9.1: **Conduct an experiment, simulation, or survey**

Key Competency Indicators:

9.1.1 Identify a hypothesis to test
9.1.2 Construct a logical procedure to test hypothesis
9.1.3 Formulate "best guess estimates" as appropriate to predict potential outcomes

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 9.2: **Perform data collection to support an experiment, simulation, or survey**

Key Competency Indicators:

9.2.1 Identify potential data and information to collect
9.2.2 Select relevant data and information to collect
9.2.3 Understand various data collection methods and instruments
9.2.4 Understand the meaning and implications of sampling and sample size
9.2.5 Select or adapt a data collection instrument to support an experiment, simulation or survey
9.2.6 Determine an appropriate sample size
9.2.7 Collect and record data using a data collection instrument
9.2.8 Conduct relevant observations and interviews to gather additional information
9.2.9 Use a spreadsheet and/or statistical analysis software to organize data

BIL: Essential

EDU:	12	AD
	I	P

Competency 9.3: Analyze and interpret data collected

Key Competency Indicators:

9.3.1 Identify and properly cite data sources
9.3.2 Assess credibility of data sources
9.3.3 Assess validity of data
9.3.4 Identify sources of error
9.3.5 Assess reliability of data
9.3.6 Use descriptive statistics to analyze and summarize data
9.3.7 Use a spreadsheet and/or statistical analysis software to analyze data

BIL: Essential

EDU:	12	AD
	I	P

Competency 9.4: Communicate results and conclusions of an experiment, simulation, or survey

Key Competency Indicators:

9.4.1 Create tabular and graphical displays of quantitative data using a spreadsheet and/or statistical analysis software (e.g., line graphs, bar graphs, scattergrams, histograms, pie charts, Pareto charts)
9.4.2 Form conclusions from findings
9.4.3 Identify salient points to include in a summary
9.4.4 Prepare a concise summary presentation (written, oral, visual)
9.4.5 Deliver a summary presentation

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 9.5: **Evaluate the reasonableness of the results or outcome**

Key Competency Indicators:

9.5.1 Understand the concept of probability of occurrence
9.5.2 Interpret the meaning of probability in terms such as odds and risks
9.5.3 Compare actual results to original "best guess estimates"
9.5.4 Assess the need for further data collection or analysis

Unit 10: Workplace Safety and Environmental Issues

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 10.1: **Demonstrate awareness of regulatory agencies and codes relevant to engineering technology**

Key Competency Indicators:
10.1.1 Define basic functions of OSHA as it applies to engineering technology
10.1.2 Define basic functions of EPA as it applies to engineering technology
10.1.3 Define basic functions of NIOSH as it applies to engineering technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 10.2: **Demonstrate practices that contribute to the creation of a hazard-free, accident-free environment in the lab and workplace**

Key Competency Indicators:
10.2.1 Wear protective attire when appropriate
10.2.2 Utilize safety shields and equipment
10.2.3 Adhere to machine shut-off and lock-out/tag-out procedures
10.2.4 Handle substances in accordance with Material Safety Data Sheets (MSDS) and other applicable guidelines
10.2.5 Maintain workplace in accordance with proper ergonomic and body mechanic principles

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 10.3: **Implement knowledge of workplace safety, ergonomic, and environmental principles**

Key Competency Indicators:

10.3.1 Evaluate a given workplace setting for compliance with regulations, guidelines and principles
10.3.2 Identify corrective action to enable compliance
10.3.3 Design a workplace that is in compliance
10.3.4 Conduct a workplace accident investigation

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 10.4: **Compare emergency response plans in a variety of workplace settings**

Key Competency Indicators:

10.4.1 Describe different types of emergency response
10.4.2 Identify procedures to be followed in the event of an emergency
10.4.3 Demonstrate knowledge of hazard communications

Unit 11: Quality

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 11.1: **Demonstrate an understanding of quality assurance and management**

Key Competency Indicators:

11.1.1 Describe the importance of ensuring the quality of products and services
11.1.2 Describe the objectives of producing prototype product before full production
11.1.3 Differentiate between defect detection and defect prevention
11.1.4 Define and identify examples of rework, salvage, and scrap
11.1.5 Determine corrective action in given situations of quality problems
11.1.6 Identify implications of quality management on product cost
11.1.7 Identify and recognize various quality assurance, continuous quality improvement, quality standards, and total quality management systems in use (e.g., Deming, Plan Do Check Act, Baldrige, ISO, QS, Six Sigma)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 11.2: **Demonstrate the use of a continuous improvement model of total quality management**

Key Competency Indicators:

11.2.1 Identify a process to study
11.2.2 Evaluate the quality of the process
11.2.3 Conduct data collection and analysis to determine the cause of the problem
11.2.4 Determine corrective action
11.2.5 Implement and evaluate corrective action

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 11.3: **Plan and conduct quality testing for a given process and product**

Key Competency Indicators:

11.3.1 Select sampling plan
11.3.2 Select equipment and instrumentation required
11.3.3 Perform testing
11.3.4 Collect and record data in an appropriate way
11.3.5 Analyze and interpret quantitative test data using spreadsheets or statistical software application
11.3.6 Prepare and communicate test results in written and oral form
11.3.7 Recommend corrective actions and process modifications, as appropriate

Unit 12: Materials

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 12.1: **Characterize various materials**

Key Competency Indicators:

12.1.1 Describe the structure, properties, and identify examples of various materials (e.g., metals, wood, ceramics, concrete, rubber, plastics, polymers, composites, etc.)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 12.2: **Demonstrate an awareness of various material processing techniques**

Key Competency Indicators:

12.2.1 Identify processing techniques for various materials
12.2.2 Recognize appropriate applications of processing techniques

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 12.3: **Demonstrate knowledge of various material finishing techniques**

Key Competency Indicators:
12.3.1 Identify finishing techniques
12.3.2 Recognize appropriate applications for finishing techniques

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 12.4: **Demonstrate a basic knowledge of various material testing techniques (e.g., hardness, tensile strength, compressive strength, ductility, homogeneity, wear resistance, temperature resistance, chemical analysis)**

Key Competency Indicators:
12.4.1 Identify material testing techniques
12.4.2 Recognize appropriate applications for material testing techniques

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 12.5: **Perform material selection for given applications**

Key Competency Indicators:

12.5.1 Describe criteria used for material selection (e.g., strength, resistance to wear, resilience, durability, availability, raw material cost, processing cost)
12.5.2 Identify alternative materials for a given application
12.5.3 Evaluate alternatives for a given application
12.5.4 Prepare and communicate a summary of material options for a given application

Unit 13: Electrical Systems

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 13.1: **Demonstrate knowledge of the basic design and use of electrical systems**

Key Competency Indicators:

13.1.1 Understand and recognize common electrical equipment and electronic components
13.1.2 Demonstrate use and care of basic test equipment (e.g., oscilloscopes, signal generators, volt-ohm meters (analog and digital)
13.1.3 Demonstrate electrostatic discharge (ESD) preventive procedures
13.1.4 Understand use of circuit protective devices (e.g., fuses, breakers)
13.1.5 Understand use of Ohm's Law (e.g., current, voltage, resistance)
13.1.6 Understand concept of power, power transformations
13.1.7 Compare AC and DC circuits by study of physical systems and schematic representations
13.1.8 Build DC series, parallel, and combination circuits

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 13.2: **Demonstrate understanding of basic electrical infrastructures**

Key Competency Indicators:

13.2.1 Understand programmable electrical components
13.2.2 Understand basic telecommunications systems
13.2.3 Understand basics of the utility infrastructure

Unit 14: Mechanical Systems

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 14.1: **Demonstrate knowledge of the basic design, use, care of machines and tools**

Key Competency Indicators:

14.1.1 Demonstrate common preventive maintenance procedures for machines and equipment such as lubrication
14.1.2 Describe machine and equipment calibration and its purpose
14.1.3 Evaluate the function of simple mechanical devices (e.g., levers, pulleys, gears, hydraulic, pneumatic)
14.1.4 Demonstrate ability to use operator's and manufacturer's manuals
14.1.5 Operate individual machines safely and properly
14.1.6 Utilize gauges, dials, and output to monitor equipment

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 14.2: **Demonstrate awareness of mechanical systems: power, energy, static forces, strength of materials, dynamics**

Key Competency Indicators:

14.2.1 Apply basic principles of forces and motion to mechanical systems (e.g., Newton's laws of motion)
14.2.2 Calculate mechanical advantage of simple machines

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 14.3: **Demonstrate understanding of basic mechanical systems**

Key Competency Indicators:

14.3.1 Understand solid and fluid mechanics and thermodynamics

14.3.2 Understand basics of the utility infrastructure (e.g., water, waste management, transportation, communication, energy)

ENGINEERING TECHNOLOGY CLUSTERS DESCRIPTOR

The engineering technology clusters are a curricular framework for further development and expansion at the local consortium level. The three clusters (Design, Process, and Product/Service) are designed with essential competencies to all fields within a cluster and then competencies specific to fields within a cluster.

This design follows the large overlap between disciplines. Engineering technologists require highly technical knowledge and skills that are both manual and theoretical. An engineering technologist works directly with the design, manufacture, and use of a product, or the design, provision, and outcome of a service. If the specialty is engineering materials, one might work with specialty materials for certain applications, help solve corrosion-related problems, or perform failure studies on products in the fields. Other career areas open to engineering technologists include product packaging and distribution, plant operations and maintenance, manufacturing, and routine testing and design.

Cluster	**Related Engineering Technology Fields**	**Engineering System Correlation**
Design	Civil Engineering Technology	**Inputs**
	Architectural Engineering Technology	
	Industrial Design Technology	

Cluster	**Related Engineering Technology Fields**	**Engineering System Correlation**
Process	Electrical Engineering Technology	**Transformation**
	Electronics Engineering Technology	
	Electromechanical/ Automation and Control Technology	
	Mechanical Engineering Technology	

Cluster	**Related Engineering Technology Fields**	**Engineering System Correlation**
Product/Service	Industrial & Systems Engineering Technology	**Outputs**
	Manufacturing Engineering Technology	
	Quality Engineering Technology	

Unit 15: Engineering Technology Design Cluster

<table>
<tr><th>Cluster</th><th>Related Engineering Technology Fields</th><th>Engineering System Correlation</th></tr>
<tr><td rowspan="3">Design</td><td>Civil Engineering Technology</td><td rowspan="3">Inputs</td></tr>
<tr><td>Architectural Engineering Technology</td></tr>
<tr><td>Industrial Design Technology</td></tr>
</table>

The curricular framework is presented for further development and expansion at the local consortium level.

Unit 15: Design Cluster Essential Competencies

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15.1: **Demonstrate knowledge of surveying techniques**

Key Competency Indicators:
15.1.1 Interpret site drawings and related documents
15.1.2 Perform basic land surveys (distance measurement, angle measurement, elevation measurement, location definition)
15.1.3 Demonstrate an awareness of global information systems (GIS)
15.1.4 Explain the implications of global information systems (GIS)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15.2: **Demonstrate knowledge of structural engineering technology**

Key Competency Indicators:
15.2.1 Apply principles of physics to statics and dynamics
15.2.2 Develop a fundamental knowledge of materials (i.e., wood, concrete, steel, plastics)
15.2.3 Evaluate loading (live load and dead load)
15.2.4 Perform structural analysis
15.2.5 Interpret structural analysis
15.2.6 Design structural system (beams, columns, girders, and connections)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15.3: **Demonstrate an advanced knowledge of computer-aided drafting and design (CADD)**

Key Competency Indicators:

15.3.1 Perform architectural drafting including residential and commercial

15.3.2 Create construction blueprints and topographic/site maps and plans

CIVIL ENGINEERING TECHNOLOGY

Career Cluster Description

Civil engineering technologists plan and design roads, bridges, high-rises, dams, airports, underwater tunnels, new and better wastewater treatment plants, solutions for highway congestion, and special tracks for magnetic levitation trains of the future. There are many specialties within this field, including environmental (pollution control, recycling, and health, safety, and environmental protection), structural (making buildings and roads earthquake-safe, designing offshore oil rigs or sports stadiums, and developing new, stronger, more economical materials with which to create the structures), and transportation (designing new systems to move people and goods safely, rapidly, and efficiently such as high-speed trains, new types of boats)

Unit 15A: Civil Engineering Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15A.1: **Demonstrate technical skills for water resource engineering technology**

Key Competency Indicators:

15A.1.1 Demonstrate knowledge of the hydrologic cycle
15A.1.2 Recognize the components of a drainage system (open channel and closed system)
15A.1.3 Calculate flow in various systems
15A.1.4 Design flow management systems (i.e., culverts, ditches, pipes)
15A.1.5 Demonstrate basic knowledge of water quality
15A.1.6 Apply the basic principles of chemistry and biology to water quality
15A.1.7 Demonstrate basic knowledge of water and wastewater treatment systems
15A.1.8 Design water and wastewater treatment systems

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15A.2: **Demonstrate technical skills for geotechnical engineering technology**

Key Competency Indicators:

15A.2.1 Demonstrate knowledge of the properties of soils and bedrock
15A.2.2 Collect soil samples by various methods including augering and core sampling
15A.2.3 Determine the properties of soil and bedrock
15A.2.4 Apply basic chemistry, earth sciences, and physics to soil and bedrock analysis
15A.2.5 Perform soil mechanics analysis including soil loading, compaction, settlement, slope stability
15A.2.6 Design shallow foundations and earth retaining structures

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15A.3: **Demonstrate a basic knowledge of environmental site assessment and remediation**

Key Competency Indicators:

15A.3.1 Recognize the impact of site development on the environment (pre-project vs. post-project)
15A.3.2 Describe the basic parameters of environmental site assessment including air, water, and land factors
15A.3.3 Identify the types of site remediation

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15A.4: **Demonstrate technical skills for transportation engineering technology**

Key Competency Indicators:

15A.4.1 Compare various transportation systems (roads and highway, rail, air, public transportation)
15A.4.2 Perform traffic analysis

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15A.5: **Demonstrate technical skills for community planning and design**

Key Competency Indicators:

15A.5.1 Identify the elements of community planning and design (e.g., infrastructure, demographics, land utilization, and zoning)
15A.5.2 Evaluate the impact of development and decline of the community
15A.5.3 Develop a community plan
15A.5.4 Construct a model of the community plan
15A.5.5 Assess the feasibility of the community plan
15A.5.6 Prepare and deliver a presentation of the community plan

BIL: Essential

EDU:	12	AD
	I	P

Competency 15A.6: Demonstrate technical skills for construction management

Key Competency Indicators:

15A.6.1 Define the concepts of design-build

15A.6.2 Identify the components of construction management (scheduling, personnel, equipment, supplies, budget)

15A.6.3 Develop a project schedule (critical path, early start - early finish, late start - late finish)

15A.6.4 Develop contingency plans

15A.6.5 Identify quality and safety issues related to construction projects

15A.6.6 Evaluate the construction management practices demonstrated in a construction project or case study

ARCHITECTURAL ENGINEERING TECHNOLOGY

Career Cluster Description

Architectural engineering technology is "the application of engineering principles to the design of technical systems of buildings". Workers in this field need to be creative and analytical, systematic and practical, aesthetic and technical. Specialties within this field include emphasis on the building's structure to withstand wind, snow or earthquake, the building's mechanical system to regulate air flow, determine wall thickness and heat sources, and HVAC systems, the electrical system throughout the building, and construction project management to focus on the safety, cost, and construction methods of designing a building.

Unit 15B: Architectural Engineering Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15B.1: **Demonstrate technical skills for site selection**

Key Competency Indicators:

15B.1.1 Identify the purpose of the project
15B.1.2 Identify the key elements of the site - capability (topography, soil, bedrock, drainage)
15B.1.3 Recognize the socioeconomic and political impacts of the site development - suitability (zoning)
15B.1.4 Evaluate site potential

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15B.2: **Demonstrate technical skills for selecting and monitoring construction methods and materials**

Key Competency Indicators:

15B.2.1 Identify basic construction methods
15B.2.2 Identify basic construction materials (wood, metals, concrete)
15B.2.3 Determine the appropriate construction methods and materials for a given project
15B.2.4 Estimate material, labor, and construction costs
15B.2.5 Monitor the construction process

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15B.3: **Demonstrate technical skills for designing plumbing, electrical, and security systems for buildings**

Key Competency Indicators:

15B.3.1 Identify basic components of a plumbing system
15B.3.2 Identify the basic components of an electrical system
15B.3.3 Identify the basic components of a security system (including anti-terrorism elements)
15B.3.4 Research local and national building, electrical, fire, plumbing codes
15B.3.5 Describe the fundamentals of fire prevention
15B.3.6 Design appropriate fire prevention, electrical, plumbing, and security systems that meet all applicable codes for a project

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15B.4: **Demonstrate a basic knowledge of architectural history, preservation, restoration, and rehabilitation**

Key Competency Indicators:

15B.4.1 Explore the history of architecture
15B.4.2 Describe the importance of determining the cultural and historical value of a site before development
15B.4.3 Describe methods of historical preservation, restoration, and rehabilitation

INDUSTRIAL DESIGN TECHNOLOGY

Career Cluster Description

Industrial designers apply the use of the most modern equipment and techniques to careers in tool design, mechanical design, product design, plant engineering, and structural and electromechanical specialties. Techniques include computer-aided drafting, land development, solids modeling, and rapid prototyping. Design technicians determine part specifications, apply dimensioning techniques, perform calculations, and determine the type and strength of materials used in industrial product design.

Unit 15C: Industrial Design Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 15C.1: **Demonstrate technical skills for industrial design technology**

Key Competency Indicators:

15C.1.1 Design drawings and requirements documentation (sketches)
15C.1.2 Tooling and manufacturing process – compare and contrast (machining and fabrication)
15C.1.3 Mechanics of materials
15C.1.4 Assembly practices and fasteners
15C.1.5 Create advanced CADD drawings (ISO, ANSI standards, dimensioning, tolerancing, internet search for components)
15C.1.6 Create solid models
15C.1.7 Rapid prototyping
15C.1.8 Test and market

Unit 16: Engineering Technology Process Cluster

Cluster	Related Engineering Technology Fields	Engineering System Correlation
Process	Electrical Engineering Technology	**Transformation**
	Electronics Engineering Technology	
	Electromechanical/ Automation and Control Technology	
	Mechanical Engineering Technology	

The curricular framework is presented for further development and expansion at the local consortium level.

Unit 16: Process Cluster

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 16.1: **Diagnose and troubleshoot electrical and electronics systems**

Key Competency Indicators:

16.1.1 Draw and interpret schematic block diagrams
16.1.2 Build analog and digital circuits according to schematics and specifications
16.1.3 Troubleshoot analog and digital circuits
16.1.4 Analyze electrical and electronics systems
16.1.5 Evaluate system fault and choose appropriate test equipment
16.1.6 Demonstrate systematic troubleshooting methods

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 16.2: **Evaluate the safety and reliability of electrical systems**

Key Competency Indicators:

16.2.1 Perform lock out/tag out procedures in the electrical/electronic environment according to industry standards
16.2.2 Develop a safety plan for specific electrical/electronic equipment
16.2.3 Identify and control protective circuit devices
16.2.4 Evaluate circuits to apply appropriate protective devices
16.2.5 Demonstrate appropriate safety procedures in working with electrical/electronic systems
16.2.6 Identify and explain use of electrical/electronic personal protective equipment (PPE)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 16.3: **Demonstrate knowledge of computer programming**

Key Competency Indicators:

16.3.1 Develop a computer program in a current language (e.g., C, C++)
16.3.2 Apply logic elements, variables, branching, if-then statements, loops in computer programs
16.3.3 Interface program to machining and other applications
16.3.4 Validate results of computer application programs
16.3.5 Solve mathematical problems using computer programs

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 16.4: **Demonstrate the use of inspection and quality assurance techniques**

Key Competency Indicators:

16.4.1 Utilize testing equipment and instrumentation, including rulers, scales, tapes, calipers, micrometers, multimeters, thermometers, coordinate measuring machines, computer-automated systems
16.4.2 Apply knowledge of metrology in testing
16.4.3 Design an inspection test
16.4.4 Select an appropriate sampling plan for an inspection test
16.4.5 Conduct testing and inspection of a product, including gage repeatability and reliability studies, capability studies

ELECTRICAL ENGINEERING TECHNOLOGY

Career Cluster Description

Electrical and electronics engineering technologists develop, test, and manufacture electrical and electronic equipment (stereos, computers, microwaves, TVs, power tools, air conditioners, major appliances, satellites, cell phones, pagers). Specialty areas include power plant work, communications, and computer, software, and optical engineering technology.

Unit 16A: Electrical Engineering Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 16A.1: **Demonstrate technical skills for electrical engineering technology**

Key Competency Indicators:

16A.1.1 Explain operations characteristics of power generating utilities
16A.1.2 Assess end-user requirements and develop power distribution methods
16A.1.3 Generate a schematic or block diagram indicating plant power layout
16A.1.4 Determine wiring requirements per National Electrical Code (NEC) standards for a variety of power applications

ELECTRONICS ENGINEERING TECHNOLOGY

Career Cluster Description

Electrical and electronics engineering technologists develop, test, and manufacture electrical and electronic equipment (stereos, computers, microwaves, TVs, power tools, air conditioners, major appliances, satellites, cell phones, pagers). Specialty areas include power plant work, communications, computer, software, and optical engineering technology.

Unit 16B: Electronic Engineering Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 16B.1: **Demonstrate technical skills for electronic engineering technology**

Key Competency Indicators:

16B.1.1 Differentiate between analog and digital systems
16B.1.2 Analyze digital circuits
16B.1.3 Analyze analog circuits
16B.1.4 Apply basic data communication techniques
16B.1.5 Apply basic telecommunications techniques
16B.1.6 Explain functions of various electronic circuit components (e.g., diodes, transistors, capacitors, inductors)
16B.1.7 Design, build, and present an electronic project

ELECTROMECHANICAL ENGINEERING TECHNOLOGY

Career Cluster Description

Electromechanical engineering technology includes the design, maintenance, and development of new applications for robots. Robotic systems enable tremendous precision, speed, and power that can be applied to manufacturing, space or underwater exploration, surgery, or environmental research. Specially designed sensors and manipulative arms and grippers are designed and controlled and incorporated into a robot.

Unit 16C: Electromechanical Engineering Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 16C.1: **Demonstrate technical skills for electromechanical engineering technology**

Key Competency Indicators:

16C.1.1 Assess requirement for a specific application to select an appropriate motor or generator
16C.1.2 Apply machine communication protocols in an industrial system
16C.1.3 Apply automated data acquisition technology to monitor system health
16C.1.4 Apply and program programmable logic controllers (PLCs) to control manufacturing systems
16C.1.5 Employ feedback control and sensor in an automated system
16C.1.6 Design, build, or troubleshoot fluid power systems (hydraulics/pneumatics)
16C.1.7 Explain use of machine sensor technology in a parts inspection application
16C.1.8 Repair, install, program, and monitor automated industrial systems
16C.1.9 Apply autonomous systems in an industrial production scenario (robotics)

MECHANICAL ENGINEERING TECHNOLOGY

Career Cluster Description

Mechanical engineering technologists design, develop, and manufacture vehicles, power systems, machines, and tools – any type of equipment that produces, transmits, or uses power. Functional areas may include research and design, product testing, or product maintenance. In the automotive industry, mechanical engineers address alternative fuel development, aerodynamics study, and suspension and brake systems, to name a few areas. Mechanical engineering technologists also may specialize in heating, ventilating, refrigerating, and air conditioning systems.

Unit 16D: Mechanical Engineering Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 16D.1: Demonstrate technical skills for mechanical engineering technology

Key Competency Indicators:

16D.1.1 Construct a free body diagram showing forces and movements of a structure at rest (static)

16D.1.2 Construct a free body diagram showing forces and movement of a structure in motion (dynamics)

16D.1.3 Model practical mechanical systems using 3D CAD software

16D.1.4 Use 3D or solid models to analyze and simulate physical objects and build a prototype to validate results

16D.1.5 Describe various energy conversions and power systems applications

16D.1.6 Investigate mechanical applications of various sizes of fans, pumps, and compressors

16D.1.7 Investigate heat transfer characteristics to determine and specify appropriate insulation materials in a machine design

16D.1.8 Test various materials to determine their strength (e.g., hardness, impact, tensile, fractures, and vibration)

16D.1.9 Model material characteristics and predict strength of engineering materials (e.g., steel, ceramics, plastics)

16D.1.10 Apply hydraulic and pneumatic theory to real world systems

16D.1.11 Describe various power transmission components (e.g., shafts, axles, sleeve/ball/roller bearings, gears/belts/chains, screws/fasteners, connections)

Unit 17: Engineering Technology Product/Service Cluster

Cluster	Related Engineering Technology Fields	Engineering System Correlation
Product/Service	Industrial & Systems Engineering Technology	**Outputs**
	Manufacturing Engineering Technology	
	Quality Engineering Technology	

The curricular framework is presented for further development and expansion at the local consortium level.

Unit 17: Product/Service Cluster

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 17.1: **Demonstrate an advanced knowledge of measurement, metrology instrumentation, and inspection and quality assurance techniques**

Key Competency Indicators:

17.1.1 Demonstrate correct use of metric and English (SI) systems and units of measure and conversion between systems

17.1.2 Demonstrate the calibration and use of precision instruments and testing equipment (e.g., scales, calipers, micrometers, multimeters, thermometers, dial indicators, computer-automated systems, coordinate measuring machines)

17.1.3 Apply knowledge of metrology in testing

17.1.4 Design an inspection test

17.1.5 Select an appropriate sampling plan for an inspection test

17.1.6 Conduct testing and inspection of a product, including gage repeatability and reliability studies and capability studies

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 17.2: **Demonstrate knowledge of engineering management principles and techniques**

Key Competency Indicators:

17.2.1 Identify examples of engineering economic analysis (e.g., cash flow equivalence, depreciation, comparison of alternatives)

17.2.2 Identify alternative forecasting techniques

17.2.3 Identify production management and control methods

17.2.4 Apply total quality management/ quality assurance techniques
17.2.5 Develop cost estimates and recommend cost control actions
17.2.6 Apply the concept of lean thinking to manufacturing and non-manufacturing processes
17.2.7 Apply the technique of value-added/non-value-added analysis

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 17.3: **Demonstrate an advanced knowledge of quality management**

Key Competency Indicators:
17.3.1 Apply the principles of probability and statistics to quality management situations
17.3.2 Utilize statistical process control methods (e.g., Pareto analysis, histograms, cause and effect analysis, root cause analysis, X-bar, R, p, np, c, and u control charts)
17.3.3 Perform process and equipment capability analyses
17.3.4 Explain the evolution of total quality management

INDUSTRIAL ENGINEERING TECHNOLOGY

Career Cluster Description

Industrial and systems engineering technologists improve productivity and quality by designing safer, more effective, efficient systems of people, machines, and work processes, or methods. "Systems thinking" enables an industrial engineering technologist to understand the role manufacturing or service provision plays in the overall business and how to customize products or services to meet the needs and suit the tastes of customers. Industrial engineering techniques may be applied to processes in many different types of organizations including manufacturing plants, hospitals, banks, insurance companies, retail, recreation and restaurant facilities, and government agencies.

Unit 17A: Industrial Engineering Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 17A.1: **Demonstrate technical skills for industrial engineering technology**

Key Competency Indicators:

17A.1.1 Understand the different types of manufacturing processes

17A.1.2 Identify the decision-making process within alternative organizational structures (e.g., traditional decision making vs. self-directed work teams)

17A.1.3 Identify and understand the use of computer control systems (i.e., computer-aided manufacturing [CAM], computer numerical control [CNC], computer-integrated manufacturing [CIM])

17A.1.4 Understand and utilize management information systems (i.e., production and inventory management, manufacturing/enterprise resource planning (MRP/ERP), work measurement and standards, project management and tracking)

17A.1.5 Create a facility/work station layout incorporating production and ergonomic principles

17A.1.6 Understand and apply lean thinking and just-in-time (JIT) production principles to a given process

17A.1.7 Perform engineering economic analyses (e.g., make vs. buy, variable vs. fixed costs, capital budgeting, cost/benefit analysis, value engineering, forecasting)

17A.1.8 Identify and apply appropriate OSHA and EPA regulations to an industrial work environment

17A.1.9 Design and perform work measurement and time studies to determine work standards

17A.1.10 Survey the application of industrial and systems engineering techniques in service industries

MANUFACTURING ENGINEERING TECHNOLOGY

Career Cluster Description

Manufacturing engineering technologists design and manage the processes by which products are made. They provide a bigger picture perspective, and work with plant managers, production supervisors, CNC programmers, quality managers, product designers, and research and development staff on issues such as evaluation of new technology, choosing equipment and suppliers, standards development, and plant organization and facility layout. Lean production, agile manufacturing, re-engineering, and quality improvement are current objectives of manufacturing system design.

Unit 17B: Manufacturing Engineering Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 17B.1: **Demonstrate technical skills for manufacturing engineering technology**

Key Competency Indicators:

17B.1.1 Demonstrate machining skills (i.e., lathe, vertical mill, drill press, surface grinder)

17B.1.2 Demonstrate fabrication, joining and assembly, forming and finishing, various heat treating techniques

17B.1.3 Demonstrate knowledge of the aspects of product design including research and development, prototyping, testing, concurrent engineering, design for manufacturing, assembly, maintenance, system and environmental constraints, engineering design analysis, engineering cost analysis, geometric dimensioning and tolerancing (GD&T)

17B.1.4 Demonstrate knowledge of process design and development including equipment and fixture design, work cell design, and workstation layout

17B.1.5 Understand and demonstrate the use of automated industrial systems including programmable logic controllers (PLCs), vision systems, sensing equipment, computer numerical control (CNC) G&M codes, programming languages, CADD interfaces, and robotics

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 17B.2: **Demonstrate technical skills for manufacturing management**

Key Competency Indicators:

17B.2.1 Explain the relationship between production systems and controls

17B.2.2 Explain the significance of material resource planning and inventory control systems

17B.2.3 Understand manufacturing supervision principles and techniques, including employee and labor relations

QUALITY ENGINEERING TECHNOLOGY

Career Cluster Description

Quality engineering technologists address the competitive pressures and customer demands of all producers of consumer and industrial products. Technical skills are applied in the areas of non-destructive testing of mechanical and electronic systems, quality improvement programs, reliability management, and systematic problem solving. Objectives include planning, organizing, managing, measuring and analyzing product or service performance and quality within an organization. An additional specialty is product packaging and distribution, and the consideration of related technical, economic, environmental and human factors including containment, dispensing, protection, informing, transport, and marketing.

Unit 17C: Quality Engineering Technology

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 17C.1: **Demonstrate technical skills for quality engineering technology**

Key Competency Indicators:

17C.1.1 Interpret and implement quality management systems (i.e., ISO, QS, Baldrige)
17C.1.2 Develop and utilize design of experiments as a tool for statistical analysis
17C.1.3 Utilize information systems for data acquisition and management
17C.1.4 Demonstrate an advanced knowledge of material characteristics and testing (e.g., tensile strength, compression, durability, hardness)
17C.1.5 Demonstrate an advanced knowledge of geometric dimensioning and tolerancing (GD&T) – characteristics and symbols, tolerances, true position, form, material conditions, datum points, references, clearance, interference and transition of mating parts

APPENDICES

Appendix A

RESOURCES

Student Contests/ Competitions

BEST – Boosting Engineering, Science, and Technology – www.bestinc.org

Contest: West Point Bicentennial Engineering Design Contest – http://bridgecontest.usma.edu

SAE – A World in Motion
Paul Lane in Dayton area: 937-847-9435
www.sae.org

Future City Competition
www.futurecity.org

SME Robotics

FIRST Lego/Mindstorm

FIRST Robotics

VICA/Skills USA and its Tech Prep-specific competition

Summer Engineering Camps for Students

SCC Women in Engineering Technologies Institute
It's free! For girls entering grades 11-12
June 17-28, 2002
Call Natalie Ingram: 937-512-2330, ningram@sinclair.edu

UD Women in Engineering Summer Camp
$325 For girls entering grades 10-12
1-week experience, includes living at UD
July 13-18, 2003
Call Karen Updyke: 937-229-3296, wie@udayton.edu
www.engr.udayton.edu/Special/wie/default.htm

Student/ Teacher Resources/References

American Engineering Campaign – www.americanengineeringcampaign.org

Miami Valley Tech Prep Consortium website
TIES Curriculum,
Professional Development offerings, and much more
www.mvtechprep.org

Wright Patterson Air Force Base Educational Outreach Office
Call to get on their distribution list (email)
Many email announcements of programs and opportunities for educators and students
Wizards of Wright (WOW) in-school demos
937-255-0692 or 937-253-7125

Accreditation Board for Engineering and Technology, Inc, (ABET), 2001-2002 Criteria for Accrediting Engineering Technology Programs, Technology Accreditation Commission (TAC of ABET), www.abet.org

American Society for Engineering Education (ASEE) – including a pre-college programs database and center in the works, www.asee.org

ASME: Guide to K-12 Instructional and Guidance Resources
IDEAS
www.asme.org in Pre-College section
Best Practices in High School Engineering –
www.asme.org/education/precollege/bestpractice.htm

Building Linkages Among Academic and Skill Standards for Manufacturing – www.mfglinks.org

The Center for Case Studies in Engineering at the Rose-Hulman Institute of Technology – www.civeng.carleton.ca/ECL/index.html

Center for Improved Engineering & Science Education (CIESE), at Stevens Institute of Technology, NJ, classroom projects, national collaborative projects, professional development for educators, www.k12science.org

Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development (CAWMSET) – www.nsf.gov/od/cawmset

Diversity/Careers in Engineering & Information Technology – especially for women and minorities, some great journal articles and success stories from the field
www.diversitycareers.com

Engineer Guy – Bill Hammack's Engineering & Life – an audio and web archive of the public radio program. Every week, Bill broadcasts, on public radio, a short community on how engineering and technology affect our lives. Sampling of most popular spots: spam, Velcro, Slinky, Project Gutenberg, e-books, Nylon… You can sign up for the free weekly email distribution of the weekly spots. www.engineerguy.com

Eisenhower National Clearinghouse for Mathematics and Science Education (ENC), www.enc.org

EPICS – Engineering Projects in Community Service – at Purdue Univ., a national program – http://epics.ecn.purdue.edu

Guide Me website – National Action Council for Minorities in Engineering (NACME) – for students, parents, educators, with many links. www.guidemenacme.org

How Stuff Works – collection of articles about the ordinary and obscure – www.howstuffworks.com

Infinity Project – Technology and Engineering Education for the New Century – Southern Methodist University School of Engineering, www.infinity-project.org

International Technology Education Association (ITEA), www.iteawww.org

JA Interprise Poll on Kids and Careers, Junior Achievement, Inc., January 2002, www.ja.org/interprise/execsummary.html

Junior Engineering Technical Society (JETS) http://www.asee.org/jets

Massachusetts Department of Education, Science and Technology/Engineering Curriculum Framework, www.doe.mass.edu/doedocs/frameworks/

MentorNet – electronic industrial mentoring network for college women in engineering, science, math, and technology – www.mentornet.net

National Alliance for Pre-Engineering Programs – Project Lead the Way – www.pltw.org

National Building Museum (Washington, D.C.) - http://www.nbm.org/Exhibits/current/MMI.html - "Me, Myself, and Infrastructure" exhibit – explores the relationship of the public to its civil engineers who are designers, builders, and managers. In commemoration of the 150th anniversary of the American Society of Civil Engineers.

National Council of Examiners for Engineering and Surveying (NCEES) – Fundamentals of Engineering Examination, Principles and Practice Examinations in specific fields - www.ncees.org

National Engineer's Week
www.eweek.org

National Institute for Certification in Engineering Technology (NICET), a division of NSPE, www.nicet.org

"Not All Engineers Drive Trains" – specifically for 2nd graders - an in-class presentation by an Ohio registered Professional Engineer, a storybook read by the engineer, a coloring book version of the book given to each student, and a statewide coloring contest for students. Sponsored by the Ohio Society of Professional Engineers (OSPE) 1-800-654-9481, ospe@iwaynet.net

Occupational Outlook Handbook - http://www.bls.gov/oco/

Ohio Career Information System (OCIS) – www.ocis.org

Ohio's Labor Market Information system – www.lmi.state.oh.us

Ohio Math & Science Coalition, "Bringing Mathematics and Science Education in Ohio Into the 21st Century", www.oai.org/OMSC

Ohio Works – www.ohioworks.com

Project SEED – Sourcebook of Demonstrations, Activities, and Experiments, Northeastern University, Center for Electromagnetics Research, (1993)

Society of Manufacturing Engineers (SME) and the SME Education Foundation – Manufacturing Education for the 21st Century, "Manufacturing Education Plan: 1999 Critical Competency Gaps", www.sme.org

Third International Mathematics and Science Study (TIMSS), http://ustimss.msu.edu

Tufts University – The Center for Engineering Educational Outreach
www.ceeo.tufts.edu

Books/ Reports

Engineering Success, Peter Schiavone, Prentice Hall, Second Edition, 2002, 188 pgs.

Engineering Ethics, Charles B. Fleddermann, Prentice Hall, 1999, 135 pgs.

Design Concepts for Engineers, Mark N. Horenstein, Prentice Hall, 2002, 236 pgs.

Engineering Design: A Day in the Life of Four Engineers, Mark N. Horenstein, Prentice Hell, 1999, 121 pgs.

I Want to Be... An Engineer, Harcourt Brace & Company, Maze Productions, 1997.

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Is There an Engineer Inside You? A Comprehensive Guide to Career Decisions in Engineering, Celeste Baine, Bonamy Publishing, 1998, 188 pgs.

Engineering Problem-Solving for Mathematics, Science, and Technology Education, Ellen Frye, Dartmouth Project for Teaching Engineering Problem Solving, Thayer School of Engineering, 1997, 135 pgs.

"A Working Method: Engineering Problem Solving for High Schools", accompanying video for book, Dartmouth Project for Teaching Engineering Problem Solving, Thayer School of Engineering, 25 min.

"Land of Plenty – Diversity as America's Competitive Edge in Science, Engineering and Technology", Report of the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development (CAWMSET), September 2000.

Studying Engineering Technology: A Blueprint for Success, Stephen R. Chesier, Discovery Press, May 1998, 320 pgs.

"A National Agenda for the Future of Engineering Technician Education", Workshop Report, Sinclair Community College, Dayton, Ohio, January 1997

The Inventive Thinking Curriculum Project: An Outreach Program of the US Patent & Trademark Office, Project XL, Third Edition.

Websites

Technical Communications website at UD: www.engr.udayton.edu/special/writing
Developed and maintained by Macy Reynolds at UD

Professional Engineering and Technical Organizations

American Academy of Environmental Engineers (AAEE) http://www.enviro-engrs.org/

American Association of Engineering Societies (AAES) http://www.aaes.org

American Consulting Engineers Council (ACEC0 http://www.acec.org

American Institute of Chemical Engineers (AIChE) http://www.aiche.org – Environmental division

American Society of Civil Engineers (ASCE) http://www.asce.org – many divisions

American Society of Mechanical Engineers (ASME) http://www.asme.org – many divisions

American Water Resources Association (AWRA) http://www.awra.org

Institute of Electrical and Electronic Engineering (IEEE) http://engine.ieee.org – many societies within

Institute of Industrial Engineers (IIE) http://www.iienet.org – many societies and divisions

Institute of Transportation Engineers (ITE) http://www.ite.org

National Academy of Engineers (NAE) http://www.nae.edu

National Society of Black Engineers (NSBE) http://www.nsbe.org

National Society of Professional Engineers (NSPE) http://www.nspe.org (and state societies)

Ohio Society of Professional Engineers – www.ohioengineer.com

Society of Automotive Engineers (SAE) http://www.sae.org

Society of Manufacturing Engineers (SME) http://www.sme.org

Society of Women Engineers (SWE) http://www.swe.org

Structural Engineering Institute (SEI) of the ASCE http://www.asce.org/sei/index.html

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Appendix B

PATHWAY TEMPLATE

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_____________ (High School)

_____________ (Career Center)

_____________ (Community College)

Tech Prep Program

_____________ (School Year)

9th GRADE	CREDIT	10th GRADE	CREDIT	11th GRADE	CREDIT	12th GRADE	CREDIT

Recommended Prerequisites for Grade 11 of Tech Prep	Recommended for College Portion of Tech Prep

Junior Year Tech Center/College Technical Courses		Senior Year Tech Center/College Technical Courses	
*Technical Subjects	On-transcript _____ College Credits	*Technical Subjects	_____ College Credits
Articulated Credits: - _____________ Community College			

Revised 2/11/02

DEGREE: ASSOCIATE OF ______________________

______________ **-Tech Prep** ______________

(Career Center) (Name of Tech Prep Program)

Term Taken	First Term	Pre-requisite	Co-requisite	Quarter Credit Hours	University Pathway Equivalent	Completed as Tech Prep Component
Term Taken	**Second Term**	**Pre-requisite**	**Co-requisite**			
Term Taken	**Third Term**	**Pre-requisite**	**Co-requisite**			

Revised 2/11/02

:GREE: ASSOCIATE OF ______________________________

______________________ **-Tech Prep** ______________________
(Career Center) (Name of Tech Prep Program)

Term Taken	Fourth Term	Pre-requisite	Co-requisite	Quarter Credit Hours	University Pathway Equivalent	Completed as Tech Prep Component
Term Taken	**Fifth Term**	**Pre-requisite**	**Co-requisite**			
Term Taken	**Sixth Term**	**Pre-requisite**	**Co-requisite**	**Quarter Credit Hours**	**University Pathway Equivalent**	**Completed as Tech Prep Component**

Revised 2/11/02

_______ **Total Quarter Credit Hours**

Appendix C

ENGINEERING TECHNOLOGY PROFILE REVIEW PANEL PARTICIPANTS

Seyed Akhavi, Dean, Information & Engineering Technologies Coordinator, E-World Learning Center, Jefferson Community College

Ronald K. Althaus, Principal (CFPIM, CIRM, C.P.M.), Consulting & Education Services, Althaus Consulting LLC

Mike Bailey, Instructor, Lorain County JVS

Craig Bales, Manufacturing Engineering Technology Instructor, Ohio Hi-Point Career Center

John Birch, Instructor, Miami University

Lynette Boggs, Drafting/Engineering Instructor, Wayne County Schools Career Center

Steve Bowman, Curriculum & Instructional Specialist, Great Oaks

Tom Carlisle, Professor, Industrial Engineering Technology, Sinclair Community College

Linnae Clinton, Consultant, Ohio Department of Education

Jon Cotterman, Teacher, Coshocton High School

Karen Cristina, Representing Engineering, Lorain Community College

Larry Curry, P.E., Chairman, Civil Engineering Technology, Lakeland Community College

Carol Damian, Science Education Resource Specialist, ENC

Joseph C. Delio, Vocational Electronic Instructor, Parma City School District

Binh Dinh, Chief Engineer, Miami Valley Regional Transit Authority

Dan Durfee, Tech Prep Liaison; Professor, Engineering & Science, Muskingum Tech

Jim Eller, Chair, Mechanical Engineering Technology, Sinclair Community College

Bob Gemin, Science & Engineering Outreach (B.S.E.E., M.S., P.E.), WPAFB Educational Outreach Office

Dennis Hance, Instructor, Upper Valley JVS

Steve Harper, Department Chairperson, Sinclair Community College

Ken Kuzon, Plant Manager, Lau Industries, Inc.

Paul Lane, Freelance Writer & Photography, Retired Engineer

Timothy C. Lehman, Mechanical Department Coordinator, Fanning/Howey Associates, Inc.

Werner C. Loehlein, Chief, Water Management Section, U.S. Army Corps of Engineers

Jean-Claude Malik Ba, Ph.D., Assistant Professor, Biological & Physical Sciences, Columbus State Community College

Beau May, Manufacturing Engineer, Rittal Corporation

Richard Parker, Manufacturing Engineering Technology Instructor, Lorain Schools - Lorain Admiral King High School

Monica Pfarr, Director, National Center of Excellence, Advanced Manufacturing Education (NCE-AME), Advanced Integrated Manufacturing Center (AIM Center)

Jeff Powell, Training & Safety Manager, OSMI

Linda Roesch, Instructor, Washington State Community College

Ken Shary, Director of Engineering, The Malish Corporation, Brush & Specialty Division

George Shay, P.E., Design Engineer/Analyst, ADS Machinery

Ron Summers, Instructor, Springfield Clark County JVS

Al Wahle, Chair, Architectural and Civil Engineering Technology, Sinclair Community College

Don Yetzer, Auto & Engineering Pathway Manager, Greater Cincinnati Tech Prep Consortium

Appendix D

SAMPLE JOB MARKET

Engineering and Engineering Technology Classified Ads
From the Dayton Daily News Spring-Summer 2002

Job Title	Company	Degree Level Required	Program Area * [if in ( ) not specifically stated, but implied]	Particular Skills
Product Engineer	Clopay Building Products Company - Russia, OH	Bachelor's (Eng. or Eng. Tech) + 3 yrs. exp.	Mechanical	Design, plan, test, communicate, and implement product engineering, import materials, value engineering
Engineering Associate	Clopay Building Product Company – Russia, OH	Associate or technical or equivalent ed/work exp.	Drafting, testing, product eng., value eng. in mfg. environment	Drawings, test apparatus, test procedures, troubleshooting, test result evaluation, corrective action and recommendations
Quality Manager	An automotive mfr/assembler – Sidney, OH	Bachelor's + 5-10 yrs. exp.	Mfg. quality	Motivated "hands-on" individual, QA, process validation, auditing, continuous improvement, ISO/QS systems, SPC, GD&T, CQE or CQA certification a plus, flexibility, problem-solving, teamwork
Training Manager	Federal Mogul – Dayton, OH	Preferred, not required	Industrial eng. w/ mfg. exp. (degree preferred but not required)	Coordinate, conduct, oversee training, QS-9000 req'ts, leadership, communication, organization, interpersonal skills
Corporate Quality Engineer	Plastipak Packaging Inc. – Jackson Center, OH	Bachelor's +3-5 exp.	Related, Quality Assurance	Facilitation, continuous improvement, new product start-up, sampling, QC training, works independently while reporting to corporate office

Job Title	Company	Degree Level Required	Program Area * [if in ( ) not specifically stated, but implied]	Particular Skills
Supervisor, Laminating	Paxar Corporation – Miamisburg, OH	Associate or equivalent + 4 yrs. Exp.	Engineering or Business	Mfg. Processes, business, multi-shift supervisory, demonstrated leadership, recognize and identify problems, decision-making, communication, ability to learn and understand effect of actions/changes on other parts of production process and/or company, self-starter, independent thinker, PC skills
Project Engineer	Green Tokai Co., Ltd. – Brookville, OH	6 yrs in plastics		Product design, automotive parts making, project management
Quality Assurance Engineer → Quality Assurance Manager	Miba Bearings US, LLC – McConnelsville, OH	Bachelor's	Quality	SPC, QS9000, QA14000, computer skills, communication, CQE or CQA certification a plus
Manufacturing Engineer	YSI Inc. – Yellow Springs, OH	Bachelor's or equivalent	Electrical, Mechanical, Industrial	Technical writing, AutoCAD, MS Office, communication, teamwork
Assistant City Manager	City of Lebanon – Lebanon, OH	Bachelor's	Civil	Project management, communication, GIS a plus
Electrical Engineer	YSI Inc. – Yellow Springs, OH	Bachelors or equivalent	Electrical/Electronics	Electronic CAD systems (PADS, PCAD), engineering documentation, Visual Basic, Visual C++, quality systems, ISO-9000, QS9000, analytical, communication, supervisory
Mechanical Designer	YSI Inc. – Yellow Springs, OH	Bachelor's, Associate, or equivalent + 3 yrs	Mechanical	Product design, documentation, CAD, Solidworks/ProEngineer and injection molding knowledge a plus
Production Coordinator	Cargill – Sidney, OH			Material management, inventory, MRP, Purchase Orders, cycle counts, attention to detail, Excel spreadsheets, phone skills, analytical

Job Title	Company	Degree Level Required	Program Area * [if in ( ) not specifically stated, but implied]	Particular Skills
Electronics Technician, Laser Technician, Mechanical Technician	Anteon Corporation – Dayton, OH	Associate or equivalent	Electrical/Electronics, with cross-training in mechanical, and machining and lasers	Schematics, diagnostic/data acquisition equipment, troubleshooting and repair, MC Office, LabView
Electro-mechanical Technician	ACT, Inc. – Springboro, OH	Associate or equivalent	Electrical/electronics	Repair, assembly, and testing of electronic and mechanical assemblies, board level analysis, video experience a plus
Plant Operator	DTE Biomass Energy – Dayton, OH	Associate	Environmental, civil	Landfill gas processing facility, self-motivated, off-hours trouble calls, advanced knowledge of mechanical, electrical, instrument and control systems, computer skills a plus.
Civil Engineering/ CADD Technician	Henderson & Bodwell, LLP – Mason, OH		Civil	Site development, design and plan production, AutoCAD/Land Development Desktop
Controls Engineer	Omega Automation – Dayton, OH	5 yrs. exp.	Electrical, mechanical, electro-mechanical	Hydraulic, pneumatic, electrical, general controls system design, PLC programming, Visual Basic, motion control, data collection, system integration, communication, hands-on, goal-oriented, teamwork, MS Office
CAM Programmer	Honda Engineering – Marysville, OH	Associate + 3-5 yrs. CAM programming exp.	Mechanical	Gibbs or Cimatron CAM software; self-directed individual
Planning Engineer	Honda Engineering – Marysville, OH	Associate + 5 yrs tooling shop/production environment exp.	Mechanical	Self-directed individual

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Die Designer	Honda Engineering – Marysville, OH	Associate + 3-5 yrs. Catia exp.	Mechanical	Self-directed individual
Mechanical Designer	Honda Engineering – Marysville, OH	Associate +3-5 yrs. production equipment/special machine design exp.	Mechanical	Strong project management and problem-solving skills; experience in taking a design from concept through install; self-directed individual
Survey Technician II	Montgomery County Engineer's Office – Dayton, OH	HS technical training + 2 yrs. survey crew or related exp.	(Civil)	Topographical, boundary surveys, Total Stations, Data Collectors, GPS Receivers
Project Engineer	Sterling PCU – Moraine, OH	Bachelor's + 1-3 yrs. exp.	(Industrial, Manufacturing, Mechanical)	Hydraulic/pneumatic design, bills of materials, continuous improvement, project management
CAD Detailer/ Draftsperson	Sterling PCU – Moraine, OH	2-yr technical program, or equiv. exp.	(Mechanical, Industrial Design)	Routine layouts, detailed drawings, sketches and diagrams for manufacture of equipment; database changes; engineering terminology; mechanical aptitude; basic mathematical calculations.
Manufacturing/ Process Engineer	Faurecia Exhaust Systems – Franklin, OH	Bachelor's	(Manufacturing, Industrial)	Automotive supplier exp (APQP, PFMEA, QS9000), laser, robotic, stamping, tube bending/end forming, MIG welding; systematic problem solver; project/program management; lean manufacturing.
Quality Engineer	Faurecia Exhaust Systems – Franklin, OH	Bachelor's	(Quality, Manufacturing, Industrial)	Automotive supplier exp (APQP, PPAP, PFMEA, QS9000, Ford Q1, GD&T), CQE/CQA preferred.
Senior Maintenance – 2nd/3rd shift	Faurecia Exhaust Systems – Franklin, OH	Associate and/or journeyman certification	(Electrical, Mechanical, Electromechanical)	Electrical – PLC/mechanical troubleshooting.

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Production Supervisor	Workhorse Custom Chassis, LLC – Union City, IN	Undergraduate degree desired + 3 yrs. production exp.		Manage daily production operations (production schedules, manpower control, product quality); managing UAW employees; computer literacy a must.
Quality Engineer	PAVE Technology Co., Inc. – Dayton, OH	ASQ CQE	(Quality)	Prepare FMEAs, PPAPs, ISO audits, SPC, inspection/test; Use Word, Excel, Access (Access programming a big plus); good business writing skills; mechanical abilities.
Technician	Alt & Witzig Enginering, Inc. – Dayton/Cincinnati/ Columbus, OH	Exp.	(Civil)	On-site construction services: testing and inspection of soils, concretes, etc.
Electrical Engineer	Goodrich Avionics Systems – Troy, OH	Bachelor's + 5 yrs. exp.	Electrical	Designing multiprocessor circuits and digital circuits, FPGAs using VHDL, environmental spec DOK160, packaging, writing specs and test procedures, troubleshooting using logic analyzers and oscilloscopes.
Senior Manufacturing Engineer/ Automotive	Saia-Burgess – Vandalia, OH	Bachelor's + 5 yrs. exp.	Manufacturing, Production Engineering	Developing, designing, improving manufacturing methods for automotive high volume assembly; analyzing and planning space req'ts; work flow and equipment layout design.
Electrical Engineer	Saia-Burgess – Vandalia, OH	Associate or Bachelor's	Electrical, Mechanical	CAD exp. a plus.

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Environmental Engineer	Panasonic/MDDA – Troy, OH	Bachelor's or equiv. technical degree + 3 yrs. environmental exp.	(Environmental, Civil)	Program development and implementation, regulatory reports, permit applications, auditing, emergency response, chemical control (MSDS & TSCA), hazardous waste mgmt; EPA & DOT regs, Title V, and strong computer (database) skills.
Production Scheduler	Stolle Products – Sidney, OH	3-5 yrs. MRP and planning exp.	(Industrial, Manufacturing)	Computerized MRP systems, PC spreadsheets, sub-contract work, APICS certification preferred; automotive and stamping process knowledge preferred; good communication skills (written and verbal); blueprint reading helpful.
Engineering Technician	City of Hamilton Department of Public Works - Hamilton, OH	Associate + drafting exp.	(Civil)	Responsible and technical work involving field and office duties, drafting and sub-professional engineering skills; CAD/Microstation, GIS, civil or traffic engineering principles and standards, public works construction, related computer software knowledge.
Quality Manager	Hohman Plating & Manfuacturing – Dayton, OH	Bachelor's – Business or Technical + 4-6 yrs. mgmt exp.	(Quality, Manufacturing)	Supervise, coordinate, document activities of personnel in Calibration & Final Inspection, Auditing, Quality Engineering, Chemical Lab. Quality system exp. (QS9000, ISO 9000/94, AS9000, NADCAP, NQA) a plus.

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Packaging Coordinator	Isuzu Manufacturing Services of America – Moraine, OH	College engineering or equiv. exp.	(Industrial, Manufacturing)	Attention to detail, good organization skills, excellent communication skills, exp. with packaging development, supplier negotiations, project management; MS Excel skills; must be able to keep required deadlines, may require flexible hours.
Order Entry/ Production Planner	Manufactured Assemblies Corp. – Vandalia, OH		(Manufacturing, Industrial)	Achievement-oriented; receiving and entering customer orders, production planning, prospecting-outbound calls, full-range customer service activities; good organization and communication skills; basic mathematics, analytic, and computer skills; detail-oriented.
Mechanical Engineer	Griffin Services – WPAFB, OH	Bachelor's + 5 yrs. exp.	Mechanical, (Civil)	Civil Engineering Support Services contract; oversight of daily ops. of a multi-skilled workforce performing maint. and construction duties; strong organizational skills, MS Office; demonstrated managerial and leadership skills. Military exp. a plus.
Industrial Engineer	Mark Concepts, Inc. – Dayton, OH	Bachelor's + 3 yrs. exp.	Industrial (Manufacturing)	Mfr of fabricated and metal stampings; knowledge of standards, capacity planning, costing.

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Tooling/ Producibility Engineer	Evenflo – Vandalia, OH	Bachelor's + 3-5 yrs. tooling exp.	Mechanical, Plastics, (Manufacturing)	Work with cross-functional teams to influence/optimize tooling programs; maintain relationships with molding suppliers/vendors; evaluation of suppliers, tooling, and part costs; development of tooling procedures and specs. Strong project mgmt, solid CAD knowledge.

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