Cleveland Heights – University Heights
City School District

Engineering Technology

COURSE OF STUDY

July, 2008

Deborah S. Delisle
Superintendent of Schools

STATEMENT OF APPROVAL

THIS COURSE OF STUDY HAS BEEN EXAMINED BY THE CLEVELAND HEIGHTS-UNIVERSITY HEIGHTS BOARD OF EDUCATION.

THE DOCUMENT WAS FORMALLY APPROVED FOR ADOPTION BY THE BOARD OF EDUCATION ON JULY 15, 2008.

RESOLUTION #08-07-092

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ACKNOWLEDGEMENTS
ENGINEERING TECHNOLOGY
CLEVELAND HEIGHTS - UNIVERSITY HEIGHTS
CITY SCHOOL DISTRICT

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Deborah Delisle, Superintendent, Cleveland Heights - University Heights City School District
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And to the Engineering Technology Advisory Committee:

Beth Bilek-Golias, AIA, NCARB, Allied ASID, LEED AP Engineering Technology Instructor
John Perrin, Coordinator, North Coast Tech Prep Consortium
Justin Hilton, Professor KSU/CAED
Zena Litvin, Engineer, Adjunct Faculty CCC

RECOMMENDATION BY CAREER AND TECHNICAL ADVISORY COMMITTEE

ENGINEERING TECHNOLOGY PROGRAM
CLEVELAND HEIGHTS-UNIVERSITY HEIGHTS SCHOOL DISTRICT

The Career Technical Advisory Committee of the Engineering Technology Program, Cleveland Heights-University Heights City School District has reviewed this course of study and recommends it for use as the foundation for instruction in classroom, laboratory and cooperative occupational experiences.

The developers of the course of study have considered local labor market needs and the school district's ability to offer specialized programs. The competencies found in the Ohio Engineering Technologies Competency Profile and program for this program have been reviewed and accepted as being congruent with our school district's philosophy and student outcome measures. Additional competencies related to the local engineering field have been incorporated into the course of study.

We believe that this course of study adequately and correctly focuses upon the development of technical competencies, attitudes, values and appreciation's critical to successful employment in the engineering field. The Engineering Technology Program Advisory Council recommended this course of study on

3/7/08
Date

Committee Chairperson

Brian Campbell
Business/Industry/Labor Member

John B Davis - First Energy Engineer
Business/Industry/Labor Member

DISTRICT PHILOSOPHY

PHILOSOPHY OF EDUCATION

The educational organization, administration, development and programs within our school system are to be guided by the following premises:

1. All children are entitled to a public education that will encourage the fullest development of their individual talents.

2. Learning is essential to individual independence and the general welfare of the changing American society.

3. Effective learning develops both intellectual and emotional qualities and is for action; its proper evaluation lies in the quality of resultant activity, not mere response.

4. Organized education, a deployment of human and material resources as means toward learning, implies learning for all -- students, teachers, administrators -- at different levels of understanding and maturity.

5. Organized education is at its best when graced with experimental attitudes and dedicated to the proposition that all issues between organization and learning shall be resolved in favor of learning.

6. All rewards and penalties adopted in the organization of education become legitimate only insofar as they assist learning.

7. For purposes of learning and growth, internal motivations are more valuable than the external, such as, grades and competition.

The primary people in our school system are first, the students, and next, the teachers. Accordingly, they will be given primary consideration in any action taken by the Board of Education.

Our school system will provide training in the basic skills.

Our school system should provide a framework in which basic problem-solving and personal adjustment methods can be learned in an orderly, phased, and wholly accessible manner.

Our school system should educate toward both responsibility and responsiveness. It should provide greatly enriched conditions for individual growth in self-awareness, in a larger social awareness, and in controlled and meaningful response both to inner and outer influences. It should strive to heighten the developing student's appreciation of the cultural and individual diversity within the human family, and improve his/her skill in working harmoniously and creatively with that diversity, since this is a rich resource for innovative and successful growth.

A major effort of the teaching-learning process should be the early development of positive self-assurance and the continuing development of individual potential to deal with a changing society, to think rationally and creatively, to be independent and productive, and to choose rewarding life activities. Thinking, creativity, independence, productivity, and activity are also characterized by individual differences. Yet they must meet external requirements, and these change with the changing society.

*Ohio Administrative Code 3301-35-02

Approved by Board of Education February 9, 1970
Revised by Board of Education January 31, 1977
Re-adopted by Board of Education January 3, 1978; March 14, 1983; December 11, 1989

PROGRAM DESIGN

ENGINEERING TECHNOLOGY PROGRAM
CLEVELAND HEIGHTS-UNIVERSITY HEIGHTS SCHOOL DISTRICT

PROGRAM GOALS

Our program goals are to meet or exceed the following:

State minimum career-technical education standards as applied to engineering technology

The criteria as determined by industry and the needs of the community

To encourage the academic and skill development of the individual to the fullest that his/her talents will permit

To encourage the individual, through participation in you organizations and other activities, to participate in improving the general welfare of a changing American society

To encourage each individual to internalize the desire for individual independence

To encourage self-assurance, discipline and motivation

To nurture the free spirit of creativity without stifling the natural individuality

To maximize the individual's decision-making and problem-solving skills

To heighten the developing student's appreciation of cultural, ethnic and individual diversity within the human family and to improve the skill of working harmoniously and creatively within that diversity

To provide foundation skills for students who wish to continue in Engineering Technology an/or related CAD fields

Program Overview

This course is designed to prepare students for a career in Engineering Technology areas or provide a background for further university-level studies. Engineering Technology and design are explored using both traditional and computer aided design. Students will learn to use drafting instruments, operate drafting computers, examine drawings and correct errors, prepare drawings and translate the ideas of others into workable plans. Additionally, students can explore other engineering-related disciplines and skills of individual interest.

POPULATION TO BE SERVED

The Engineering Technology program is open to all eleventh-and twelfth-grade students interested in employment in an engineering or engineering-related career. Selection for participation in the program will be made regardless of gender or the economic, cultural or ethnic background of the student. Students must have completed Algebra 1 and Geometry and be accepted in the next sequential math in order to be admitted to the program.

HOUSING OF THE PROGRAM

The Engineering Technology program is taught in a laboratory with an integral classroom. Depending on student performance, experience, interpersonal skills and availability, the student will have the opportunity to participate in work placement experiences and improvement projects conducted in various locations in the area.

SUPERVISOR OF THE PROGRAM

Coordinator of Career and Technical Education

OCCUPATIONS ADDRESSED BY THE PROGRAM

Engineering Technology prepares students for entry-level employment in an engineering-related field or post-secondary education. Students could work as a manual drafter or a CAD operator. Further education in mechanical, architectural, electrical, electronic and computer-aided manufacturing fields is available.

BASIC PROGRAM OPERATION

This program provides classroom and laboratory experiences in and out of school. The Engineering Technology program provides the student with the opportunity to develop fundamental knowledge, skills and abilities that will enable the student to seek employment in engineering technology fields.

FIELD EXPERIENCE AND/OR EARLY PLACEMENT

The Engineering Technology program includes in-school laboratory and out-of-school entrepreneurship and occupational placement experiences. The teacher, student, parents, and the employer plan this experience. The instructor supervises al extended education experiences. The student and employer are required to keep the appropriate records of experiences and competencies. Students must have obtained a grade-point-average acceptable to the program administrator in order to be accepted in the co-op program.

ARTICULATED AGREEMENTS

- Is an approved program under Ohio Department of Education
- Cuyahoga Community College

INTEGRATED ACADEMICS

The Engineering Technology program provides both the eleventh-grade and the twelfth-grade student with 200 minutes of combined lab and academics.

Academics related for the field, students take Algebra II/Advanced Math, Physics and an English course that surveys communications needed for the workplace. These courses, taught by academic teachers, are taken over a two-year period and are a required part of the program.

TECHNOLOGY

Technology is an ever-changing part of the program and is a varied as the agencies involved. The Engineering Technology program promotes knowledge and skill development in interpersonal relations, engineering principles, manipulative skills and other technological applications.

This program teaches the underlying concepts and principles as applied and transferable knowledge.

We encourage student participation in related skill contests at the local, state and national levels.

STUDENT LEADERSHIP

The Engineering Technology program encourages student participation in Skills USA as an integral part of the in-school program. The program encourages student participation in out-of-school leadership, citizenship and cooperative activities, including leadership activities at the local, state and national levels.

CRITICAL THINKING AND DECISION MAKING

The Engineering Technology program develops the use of critical thinking skills in making wise decisions as an integral part of classroom instruction and laboratory learning activities.

The program teaches decision-making techniques through the "problem-solving" approach, which includes the identification of options, the selection and testing of an opinion, and determination of a solution or conclusion.

DISCLAIMER STATEMENT

This course of study conforms to all federal, state and local laws and regulations including Title IX and nondiscrimination against any student because of race, color, creed, sex, religion, citizenship, economic status, marital status, pregnancy, handicap (or other physical characteristics), age, or national origin. This policy of nondiscrimination shall also apply to otherwise qualify handicapped individuals.

Key to Profile Codes

Importance of Competencies

All of the competencies in this document represent the minimum requirements for a College Tech Prep program. It is the responsibility of the local consortia to further define and/or expand, as needed, the descriptors for each competency. Each competency must be taught at the Proficient level (P) by the completion of the College Tech Prep program, which is an Associate Degree (AD). A minimal number of competencies have been identified as Introduce (I) at the Associate Degree level. These may require further higher education.

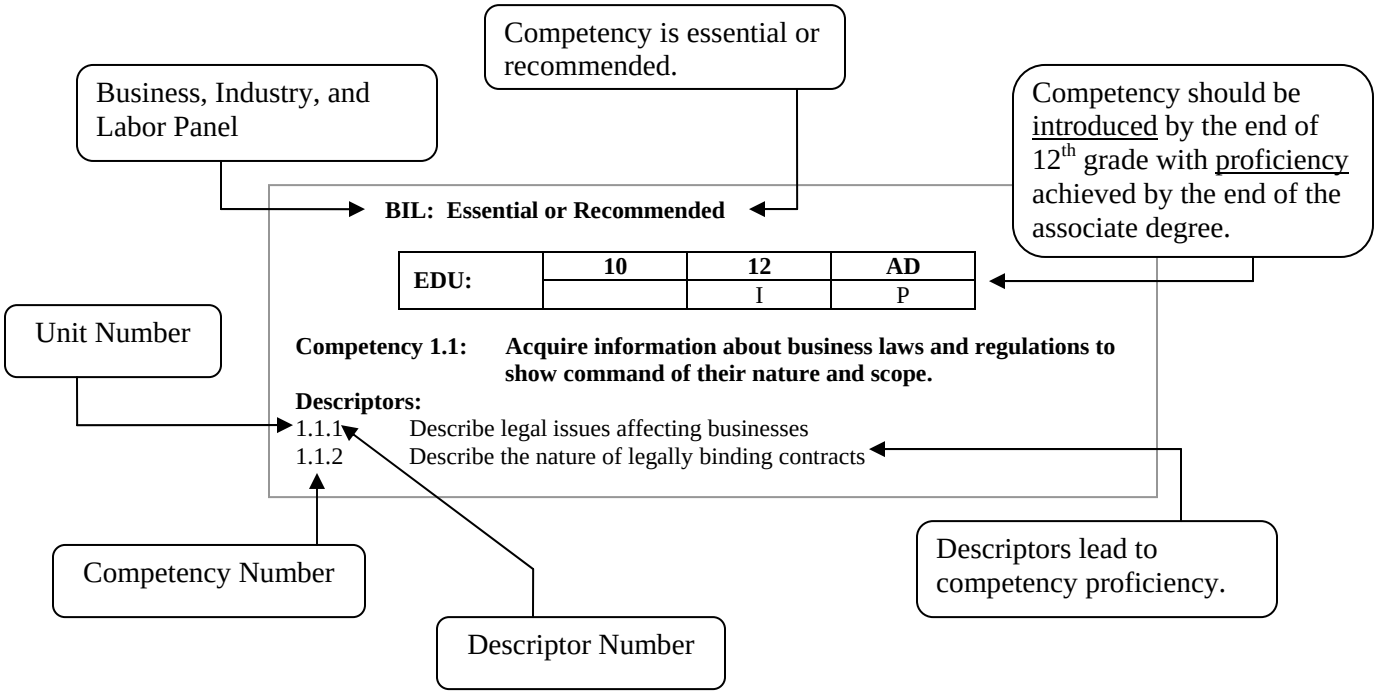
This document integrates college prep academics with technical skill. Technical skills are a required component.

- **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.)
- **R** = **Reinforced** (Competencies marked proficient at the secondary level are to be reinforced at the associate degree level.)

Grade Level:
- **10** = by the end of grade 10
- **12** = by the end of grade 12
- **AD** = by the end of the Associate Degree

Academic Connection:
As rigorous programs of study, College Tech Prep and Career-Technical programs required academics to be taught at a college preparatory level, and contextually within the technical content. State academic mathematics and language arts benchmarks are embedded within the Career Field Technical Content Standards Document (CFS).

Example of Profile Codes



SCOPE & SEQUENCE

JUNIOR YEAR PROGRAM

ENGINEERING TECHNOLOGY
CLEVELAND HEIGHTS-UNIVERSITY HEIGHTS
SCHOOL DISTRICT

Unit 1: Engineering Technology in Society

BIL: **Essential**

	11	12	AD
EDU:	I	R	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**

	11	12	AD
EDU:	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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 Identify common project scheduling techniques (e.g., critical path methodology (CPM), Project Evaluation and Review Technique (PERT)) and their ramifications on project completion
6.3.4 Demonstrate appropriate progress monitoring techniques (e.g., communication, observation, worksite inspection, critical task identification)
6.3.5 Conduct contingency planning as required for a project
6.3.6 Prepare and communicate project status reports to supervisor and stakeholders outside the team
6.3.7 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:	11	12	AD
	I	R	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**

	11	12	AD
EDU:	I	R	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**

	11	12	AD
EDU:	I	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**

	11	12	AD
EDU:	I	R	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**

EDU:	11	12	AD
	I	R	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**

EDU:	11	12	AD
	I	R	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:	11	12	AD
	I	R	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**

	11	12	AD
EDU:	I	R	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**

	11	12	AD
EDU:	I	R	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**

	11	12	AD
EDU:	I	R	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:	11	12	AD
	I	R	P

Competency 8.9: **Demonstrate fundamental understanding of LEED principles**

Key Competency Indicators:

8.9.1 Demonstrate knowledge of the LEED rating system
8.9.2 Demonstrate understanding of 3 LEED versions
8.9.3 Demonstrate understanding of the LEED Accredited Professional
8.9.4 Demonstrate knowledge of certification (e.g., Certified, Silver, Gold, Platinum)
8.9.5 Understand the importance of alternative energy sources (bioenergy, solar poser, wind power, hydroelectric power, hydrogen fuel cells, heat pumps)
8.9.6 Understand ‘Cradle to Grave’ materials and technologies

SCOPE & SEQUENCE

SENIOR YEAR PROGRAM

ENGINEERING TECHNOLOGY
CLEVELAND HEIGHTS-UNIVERSITY HEIGHTS
SCHOOL DISTRICT

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, pie 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)

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)

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

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

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, and 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, millimeters, 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
	Industrial & Systems Engineering Technology	

Product/Service	Manufacturing Engineering Technology	Outputs
	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

STUDENT ASSESSMENT POLICY
ENGINEERING TECHNOLOGY
CLEVELAND HEIGHTS – UNIVERSITY HEIGHTS SCHOOL DISTRICT

The student shall perform competencies and competency builders in a manner acceptable to the engineering industry. The standards set for these competencies are recommended by the advisory committee members and employers in the engineering industry and evaluated by the teacher following these guidelines. Competencies will be identified which must be mastered in order to receive credit for the course.

In order to measure the progress of each student in the program and to measure the effectiveness of the total program, the following assessment procedures will be used:

- Pretests
- Post tests
- Teacher observation and evaluations
- Self evaluations
- Class discussions and demonstrations
- Projects Development and Construction
- Oral Tests
- Daily Grades
- Lab and Related Class performance
- Training Plan
- Board Adopted rules and regulations
- Work/field experiences, business partnership evaluations
- Final Exam

Measurement of learning will be an ongoing activity with emphasis on laboratory activities and competency improvement. Assessment will be accomplished through pre-assessment of student skills, frequent formative assessment, both orally and written, and summative assessment to determine mastery of competencies. The number of competencies mastered will be translated into appropriate grades consistent with both the schools grading system and school district policy. When a student, grades nine through twelve, accumulates six unexcused absences or fifteen excused and/or unexcused absences in a class at any time during the semester, the student automatically receives a grade of "FA" to indicate failure due to absence.

100 – 90 = A
89 - 80 = B
79 - 70 = C
69 - 60 = D
59 - 0 = F

At the completion of the program each student will receive a Career Passport indicating competencies in which student is proficient.