Courses of Study  
For  
Project Lead The Way  

Courses in the Engineering and Design

1. Engineering Design 175001
2. Engineering Principles 175002
3. Digital Electronics 175007
4. Engineering Capstone 175009
5. Robotics 175004

CTPD 023

WEST SHORE CAREER -TECHNICAL DISTRICT  
LAKEWOOD, OHIO   44107
Example:

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Sincere appreciation goes to the following individuals for their assistance and cooperation in preparing this Project Lead The Way program’s course of study.

Example:

Lakewood Board of Education, Lakewood City Schools
Mr. Jeffrey Patterson, Superintendent, Lakewood City Schools
Mr. Keith Ahearn, Lakewood High School Principal
Mrs. Linda Thayer, West Shore Career and Technical
Mr. Robert Sedlak, Instructor, Principles of Engineering
Mr. Edward Holmok, Instructor, Digital Electronics

Project Lead The Way Advisory Committee:

<table>
<thead>
<tr>
<th>Marty Albrecht, Industry</th>
<th>Jeremy Lavelle, former student &amp; engineer</th>
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<tbody>
<tr>
<td>Maria Baker, Industry</td>
<td>Dr. M. Rashidi, CSU professor</td>
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<tr>
<td>David Beargie, former student &amp; engineer</td>
<td>Karl Scheucher, Industry</td>
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<td>Mary K. Denning, Industry</td>
<td>Robert Sedlak, PLTW instructor</td>
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<td>Jose Estermera, Educator</td>
<td>Nick Stipanovich, Industry</td>
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<tr>
<td>Ian Foye, former student &amp; engineer</td>
<td>Jennifer Sulc, Industry</td>
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<tr>
<td>Mike Francu, LHS counselor</td>
<td>N. Teig,</td>
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<tr>
<td>Leaf Holland, former student &amp; college student</td>
<td>Phil Weber, Industry</td>
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<tr>
<td>Edward Holmok, PLTW instructor</td>
<td>John Zanghi, parent &amp; patent attorney</td>
</tr>
<tr>
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<td>Joan Zbin, parent of former student &amp; civil engineer</td>
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Recommendation of Advisory Committee  
Project Lead The Way  
West Shore Career & Technical District

The Career & Technical Advisory Committee of the Project Lead The Way Program, West Shore Career & Technical 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 on the engineering and science technologies standards for this program have been reviewed and accepted as being congruent with our school district’s philosophy and student outcome measures.

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 business realm.

After reviewing this document, we recommend that the Project Lead The Way Course of Study be approved and adopted on __________________.

(Date)

_________________________  __________________________
_________________________  __________________________
_________________________  __________________________

_________________________  __________________________
Resolution (Sample)
Project Lead The Way
West Shore Career & Technical District

WHEREAS, the Project Lead The Way advisory Committee of the Lakewood City Schools has reviewed the Project Lead The Way Course of Study, and WHEREAS, the course of study is based upon the Career Content Standards Competencies for Project Lead The Way, Introduction To Engineering, Principles of Engineering, Digital Electronics, Robotics, Engineering Design and Development.

WHEREAS, the Project Lead The Way Advisory Committee has reviewed these competencies and has edited competencies to address local labor market needs, and to acknowledge the school district’s ability to offer specialized programs,

NOW, THEREFORE, BE IT RESOLVED, in accordance with the superintendent’s recommendation, that the Lakewood City Schools adopt the Project Lead The Way Course of Study.

Approval date: __________________

________________________________   __________________________________
Superintendent                                      Board President
MISSION STATEMENTS
PROJECT LEAD THE WAY
WEST SHORE CAREER AND TECHNICAL EDUCATION DISTRICT

Mission of Lakewood City Schools
In partnership with our families and community, Lakewood City Schools will develop responsible citizens, who are critical and creative thinkers, committed to life-long learning, invested in a diverse society, and prepared for technological and global opportunities.

West Shore Career Technical District Mission Statement
The many enhancements to the West Shore Career-Technical District facility, technology, and curriculum support the ongoing mission of our teachers, administration, and staff to provide excellent educational opportunities and meaningful real-world experiences while preparing students for success in the global marketplace of the 21st century.
CAREER AND TECHNICAL EDUCATION GOALS
PROJECT LEAD THE WAY
WEST SHORE CAREER AND TECHNICAL EDUCATION DISTRICT

• Offer relevant, hands-on learning opportunities which align with student career interests and regional workforce development needs

• Prepare career-tech student for post-secondary opportunities or to directly enter the workforce.

• Maintain active advisory committees which offer overall curriculum direction and specific occupational knowledge of competencies required for each industry specific committee

• Offer career exploration opportunities to expose students to career

• Upgrade career-technical labs to align with industry standards

• Provide on-going industry training and development opportunities for career-tech staff to stay abreast of industry advancements and teaching methods.
PROGRAM DESIGN
PROJECT LEAD THE WAY
WESTSHORE CAREER AND TECHNICAL EDUCATION DISTRICT

PROGRAM PHILOSOPHY:

We believe the Project Lead the Way program should provide all interested students with appropriate skills to make a smooth transition through the variety of educational environments into entry-level engineering fields of study whether in business or in further academic studies areas.

We believe the curriculum should have a firm basis in providing the students with the necessary communications, mathematics, science, and reasoning skills for success on the job.

We believe that the Project Lead The Way program should offer leadership and academic training necessary for further studies in the engineering field, employability opportunities, citizenship, and cooperative activities so that students may gain experience in making decisions and accepting responsibility for their actions.

We believe the program offers life-long learning skills needed to:
- survive in a technical society
- engage in entrepreneurial endeavors and maximize their potential as productive citizens

PROGRAM GOALS:

Program goals for students attending the West shore Career and Technical school include:

- Students will develop the skills, knowledge, attitudes, and values sufficient to secure employment and/or pursue post-secondary education in the field of their choice.
- Students will develop, expand, and refine math, science, and communication skills through application appropriate to the world of work and necessary for everyday success.
- Student will demonstrate occupational competencies at a level of proficiency acceptable to the employment market and to demonstrate the ability to adapt, retrain, and advance in an ever changing work environment.
- Students will demonstrate an understanding of positive work ethics, attitude, self-concept, and preserve mental and physical health as it relates to the processes of managing work, family, and use of leisure time.
- Students will participate in career and technical student organization activities to the extent of improved skills, knowledge, and self-concept needed for success.
- Students will demonstrate communication and basic computer operations skills to solve problems that will be encountered on a day to day basis.
- Students will receive exposure to "high tech" procedures needed to meet the demands of business and industry.
Students will value the free enterprise system and know they are able to work as entrepreneurs as well as employers.

Students who are educationally, economically, and/or physically disadvantaged are mainstream unless the disability prevents the student from benefiting from the program or creates a significant safety hazard to self or other students.

Overview of Program Project Lead The Way

The Project Lead the Way program at Lakewood High School is currently a program designed for 9th, 10th, 11th, and 12th grade students who are interested in pursuing post-secondary education upon graduation. The program curriculum is based the five individual courses from the Ohio Department of Education. Technical Competency Profiles for Engineering Technologies. This curriculum is the result of a comprehensive review of the PLTW Advisors and refinement of the State’s TCP Engineering Technologies document by a panel of representatives from secondary, post-secondary and business leaders.

Students are encouraged to take the proper classes so that they are prepared for their next step in their educational careers. The following pathway chart is a recommended sequence for students interested in this career field of Pre-Engineering.

<table>
<thead>
<tr>
<th>9th Grade</th>
<th>10th Grade</th>
<th>11th Grade</th>
<th>12th Grade</th>
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<tbody>
<tr>
<td>English 1</td>
<td>English 2</td>
<td>English 3</td>
<td>English 4</td>
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<tr>
<td>Algebra 1 or</td>
<td>Geometry or</td>
<td>Algebra II or</td>
<td>Pre-Calculus or</td>
</tr>
<tr>
<td>Geometry II</td>
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<td>Pre-Calculus</td>
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<tr>
<td>Biology or</td>
<td>Chemistry or</td>
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<td>Social Studies</td>
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<td>Social Studies</td>
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<td>Music/ Art/ PE</td>
<td>Music/Art/PE</td>
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</table>

In the 9th, 10th and 11th grade components of the Tech Prep program, all students are part of a seamless curriculum, which allows student to transition into post-secondary programs. Each competency and competency builder in the required curriculum is designated to be introduced, reinforced, or mastered at various levels.

The basic instructional philosophy for the Tech Prep programs encourages project-based learning. To this end, a senior project will be completed by each student as a culmination of their high school exit from tech prep. An advisory committee comprised of representatives from business and industry, program graduates and academic representatives from school meets twice each year to provide input and guidance in this program.

Students enrolled in Project Lead the Way are also members of North Coast Tech Prep consortia. Students are also encouraged to participate in the Tech Prep Regional Showcase.
Population Served Project Lead The Way

PLTW Tech Prep programs are open to all grades 9 through 12. It is strongly suggested that entering freshman are taking geometry concurrent with the Engineering Design and must complete a calculus course by the time they graduate from high school.

Housing of the Program

- Classroom and laboratory
- Fieldtrips to provide learning experiences outside the classroom
- Partnership with business to provide an additional hands-on training

Supervisor of the Program

The teacher of the Project Lead The Way programs report directly to the West Shore Career and Technical Director

Occupations Addressed

- Engineering Technician
- All types of Engineering Fields
- Computer Technician
- Engineering Design
- Entrepreneur

Basic Program Operation

Provide classroom instruction and laboratory experience. Develop fundamental knowledge, skills, abilities, values, and attitudes in entrepreneurship, leadership, and employability skills. Related class is forty minutes a day for a total of 3.3 hours per week. The Lab experience is for forty minutes a day for a total of 3.3 hour per week

Articulation Agreements

Articulation agreements have been developed between West Shore Career and Technical District and Cuyahoga Community College trough Tech-Prep. There is on-going dialogue following the established process and procedures between our school and each participating post-secondary institution to develop and maintain articulation agreements. The procedure can include post-secondary options, waiver of classes or other formats providing time-shortened or advanced skill associate degree paths.

West-Shore Career Tech has the following approved articulation number CTEET002. Students will get credit if they fill out an application obtainable in the CTE offices and they attend one of the approved colleges. To receive college credit students must maintain a 3.0 GPA in their Tech Prep programs and an overall GPA of 2.0 and maintain a 95% attendance rate.
Technology
Technology is an integral part of the Project Lead the Way program. Computer hardware and software are maintained as state-of-the-art Instructional delivery of curriculum through technology is the norm for this class.

Integrated Academics
Academics are taught outside the CTE program by a licensed teacher, however, is integrated as part of this program in order to raise standards. Math, Science, English and Communications skills are essential and integral parts of the program competencies.

Student Leadership
- It is anticipated that students will:
  - develop study habits commensurate with the workload
  - maintain workbooks and sketch books throughout each year
  - understand course requirements occasionally demand that students work in groups, and that the success of the group equates to the lowest common denominator

Critical Thinking and Decision Making
Develops the use of critical thinking skills in making wise decisions as an integral part of classroom instruction and laboratory learning activities
Teaches decision-making techniques through problem solving, case studies, and real life experiences

Statement of Modifications
Significant academic accommodations and/or modifications of competency to the Project Lead the Way curriculum may limit or prevent successful training and/or future employment options in this area. Also accommodations and/or modification necessary for physical limitations and/or social work behaviors may also limit or prevent successful training and/or future employment options in this area. Minor modification of competencies taught may be needed to accommodate students enrolled in the class through an Individual Education Plan (IEP) and 504

Disclaimer Statement
This Course of Study conforms to all federal, state and local laws and regulations including Title IX and non-discrimination against any student because of race, color, creed, sex, religion, citizenship, economic status, married status, pregnancy, handicap, other physical characteristics, age or national origin. This policy of nondiscrimination shall also apply to otherwise qualify handicapped individuals.
Course Description:
The focus of Engineering Design is the application of the engineering design process. Topics include work-processes, optimization methods, design optimization, and risk management tools. Students will use 2D and 3D modeling software to help them design solutions to solve proposed problems, document their work, and communicate solutions. Additionally, students will interpret industry prints, and create working drawings from functional models. Emphasis is given to experimental problem solving in real systems.
SCOPE AND SEQUENCE
ENGINEERING DESIGN
WESTSHORE CAREER AND TECHNICAL EDUCATION DISTRICT

Employability skill are taught extensively in the Senior Capstone course however review, retaught and test for competency in this course.

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

Outcome: 1.1. Employability Skills:
I CAN… Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

Competencies
1.1.1. Identify the knowledge, skills, and abilities necessary to succeed in careers.
1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.
1.1.3. Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options.
1.1.4. Describe the role and function of professional organizations, industry associations, and organized labor and use networking techniques to develop and maintain professional relationships.
1.1.5. Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, résumé writing, interviewing skills, portfolio development).
1.1.6. Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles.
1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.
1.1.8. Identify the correlation between emotions, behavior, and appearance and manage those to establish and maintain professionalism.
1.1.9. Give and receive constructive feedback to improve work habits.
1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.
1.1.11. Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them.
1.1.12. Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits, and abusive behavior.

An “X” indicates that the pathway applies to the outcome.

| Pathways | X | Operations | x | Design |
Outcome: 1.2. Leadership and Communications:
I CAN… Process, maintain, evaluate, and disseminate information in a business. Develop leadership and team building to promote collaboration.

Competencies
1.2.1. Extract relevant, valid information from materials and cite sources of information.
1.2.2. Deliver formal and informal presentations.
1.2.3. Identify and use verbal, nonverbal, and active listening skills to communicate effectively.
1.2.4. Use negotiation and conflict-resolution skills to reach solutions.
1.2.5. Communicate information (e.g., directions, ideas, vision, workplace expectations) for an intended audience and purpose.
1.2.6. Use proper grammar and expression in all aspects of communication.
1.2.7. Use problem-solving and consensus-building techniques to draw conclusions and determine next steps.
1.2.8. Identify the strengths, weaknesses, and characteristics of leadership styles that influence internal and external workplace relationships.
1.2.9. Identify advantages and disadvantages involving digital and/or electronic communications (e.g., common content for large audience, control of tone, speed, cost, lack of non-verbal cues, potential for forwarding information, longevity).
1.2.10. Use interpersonal skills to provide group leadership, promote collaboration, and work in a team.
1.2.11. Write professional correspondence, documents, job applications, and résumés.
1.2.12. Use technical writing skills to complete forms and create reports.
1.2.13. Identify stakeholders and solicit their opinions.
1.2.14. Use motivational strategies to accomplish goals.

An “X” indicates that the pathway applies to the outcome.

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Outcome: 1.3. Business Ethics and Law:
I CAN… Analyze how professional, ethical, and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

Competencies
1.3.1. Analyze how regulatory compliance affects business operations and organizational performance.
1.3.2. Follow protocols and practices necessary to maintain a clean, safe, and healthy work environment.
1.3.3. Use ethical character traits consistent with workplace standards (e.g., honesty, personal integrity, compassion, justice).

1.3.4. Identify how federal and state consumer protection laws affect products and services.

1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], U.S. Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

1.3.6. Identify deceptive practices (e.g., bait and switch, identity theft, unlawful door-to-door sales, deceptive service estimates, fraudulent misrepresentations) and their overall impact on organizational performance.

1.3.7. Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g., harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act, Fair Labor Standards Acts, Equal Employment Opportunity Commission).

1.3.8. Verify compliance with computer, copyright, and intellectual property laws and regulations.

1.3.9. Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal, organizational, and professional ethical standards.

An "X" indicates that the pathway applies to the outcome.

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Outcome: 1.4. Knowledge Management and Information Technology:
I CAN… Demonstrate current and emerging strategies and technologies used to collect, analyze, record, and share information in business operations.

Competencies
1.4.1. Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems).

1.4.2. Select and use software applications to locate, record, analyze, and present information (e.g., word processing, electronic mail, spreadsheet, databases, presentation, Internet search engines).

1.4.3. Verify compliance with security rules, regulations, and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to industry pathway.

1.4.4. Use system hardware to support software applications.

1.4.5. Use information technology tools to maintain, secure, and monitor business records.

1.4.6. Use electronic database to access and create business and technical information.

1.4.7. Use personal information management and productivity applications to optimize assigned tasks (e.g., lists, calendars, address books).

1.4.8. Use electronic media to communicate and follow network etiquette guidelines.
Outcome: 1.5. Global Environment:
I CAN… Evaluate how beliefs, values, attitudes, and behaviors influence organizational strategies and goals.

Competencies
1.5.1. Describe how cultural understanding, cultural intelligence skills, and continual awareness are interdependent.
1.5.2. Describe how cultural intelligence skills influence the overall success and survival of an organization.
1.5.3. Use cultural intelligence to interact with individuals from diverse cultural settings.
1.5.4. Recognize barriers in cross-cultural relationships and implement behavioral adjustments.
1.5.5. Recognize the ways in which bias and discrimination may influence productivity and profitability.
1.5.6. Analyze work tasks for understanding and interpretation from a different cultural perspective.
1.5.7. Use intercultural communication skills to exchange ideas and create meaning.
1.5.8. Identify how multicultural teaming and globalization can foster development of new and improved products and services and recognition of new opportunities.

Outcome: 1.6. Business Literacy:
I CAN… Develop foundational skills and knowledge in entrepreneurship, financial literacy, and business operations.

Competencies
1.6.1. Identify business opportunities.
1.6.2. Assess the reality of becoming an entrepreneur, including advantages and disadvantages (e.g., risk vs. reward, reasons for success and failure).
1.6.3. Explain the importance of planning your business.
1.6.4. Identify types of businesses, ownership, and entities (i.e., individual proprietorships, partnerships, corporations, cooperatives, public, private, profit, not-for-profit).

1.6.5. Describe organizational structure, chain of command, the roles and responsibilities of the organizational departments, and interdepartmental interactions.

1.6.6. Identify the target market served by the organization, the niche that the organization fills, and outlook of the industry.

1.6.7. Identify the effect of supply and demand on products and services.

1.6.8. Identify the features and benefits that make an organization’s product or service competitive.

1.6.9. Explain how the performance of an employee, a department, and an organization is assessed.

1.6.10. Describe the impact of globalization on an enterprise or organization.

1.6.11. Describe how all business activities of an organization work within the parameters of a budget.

1.6.12. Describe classifications of employee benefits, rights, deductions, and compensations.

An “X” indicates that the pathway applies to the outcome.

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Outcome: 1.9. Financial Management:

I CAN... Use financial tools, strategies, and systems to develop, monitor, and control the use of financial resources to ensure personal and business financial well-being.

Competencies

1.9.1. Create, analyze, and interpret financial documents (e.g., budgets, income statements).

1.9.2. Identify tax obligations.

1.9.3. Review and summarize savings, investment strategies, and purchasing options (e.g., cash, lease, finance, stocks, bonds).

1.9.4. Identify credit types and their uses in order to establish credit.

1.9.5. Identify ways to avoid or correct debt problems.

1.9.6. Explain how credit ratings and the criteria lenders use to evaluate repayment capacity affect access to loans.

1.9.7. Review and summarize categories (types) of insurance and identify how insurances can reduce financial risk.

1.9.8. Identify income sources and expenditures.

1.9.9. Compare and contrast different banking services available through financial institutions.

1.9.10. Identify the role of depreciation in tax planning and liability.

An “X” indicates that the pathway applies to the outcome.

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</table>
Standard 0.1: I CAN….choose ethical courses of action in all work assignments and personal interactions
0.1.1 Establish a personal code of ethics
0.1.2 Ensure that personal code of ethics is consistent with the professional code of ethics of the chosen profession
0.1.3 Identify strategies that strengthen desirable character traits (including honesty, integrity, compassion, empathy, justice)
0.1.4 Identify consequences of unethical conduct
0.1.5 Recognize conflict between personal/professional ethics and the ethics of others
0.1.6 Demonstrate awareness of legal responsibilities (e.g., copyright laws, harassment, equity)
0.1.7 Identify strategies for responding to the unethical actions of individuals and organizations

Standard 0.2: I CAN Implement safety procedures and programs
0.2.1 Identify safety requirements
0.2.2 Demonstrate knowledge of safety rules and guidelines
0.2.3 Interpret safety signs and symbols
0.2.4 Demonstrate desirable safety attitudes and habits
0.2.5 Use safety equipment in accordance with established procedures
0.2.6 Document results of safety procedures and programs

Strand 5. Pre-Engineering: Design and Development
Learners apply principles of design and development related to the design process, sketching and visualization, modeling, drafting, materials and production and process design.

Outcome: 5.1. The Design Process:
I CAN… Use the engineering design process and quality assurance principles to analyze and solve design problems.

Competencies
5.1.1. Describe the role of research, development, and experimentation in design problem solving.
5.1.2. Conduct an investigation to identify customer needs, constraints, and criteria.
5.1.3. Develop multiple solutions and select an approach.
5.1.4. Develop a design proposal and make a model/prototype.
5.1.5. Evaluate and redesign a prototype using collected data.
5.1.6. Utilize process planning and improvement tools to manage the life cycle of a product.
5.1.7. Compare and contrast design considerations for product recycling or disposal for the end of a product's life cycle.
5.1.8. Maintain an engineering journal to document progress and capture ideas during the development phase.

An “X” indicates that the pathway applies to the outcome.

| Pathways | Operations | X | Design |
Outcome: 5.2. Sketching and Visualization:
I CAN… Conceptualize and sketch design projects and components.

Competencies
5.2.1. Compare and contrast technical sketching and drawing.
5.2.2. Sketch possible solutions to an existing design problem.
5.2.3. Use tolerancing techniques when dimensioning.
5.2.4. Apply annotations on sketches and drawings.
5.2.5. Create sketches using integration sketching techniques and styles.
5.2.6. Apply coordinate systems (e.g., absolute, relative, user, cylindrical, Cartesian).
5.2.7. Sketch geometric forms and shapes.
5.2.8. Describe geometric constraints.
5.2.9. Select a view to graphically communicate a design solution.

An “X” indicates that the pathway applies to the outcome.

Outcome: 5.3 Computer-Aided Modeling:
I CAN… Create models to illustrate the design of projects and components.

Competencies
5.3.1. Apply manufacturing processes (e.g., casting, molding, forming, separating, conditioning, assembling, finishing, rapid prototyping).
5.3.2. Evaluate a sketch and generate a model utilizing three-dimensional modeling software and techniques.
5.3.3. Compare and contrast conceptual, physical, and mathematical design models used to check proper design.
5.3.4. Perform part manipulation during the creation of an assembly model.
5.3.5. Analyze assembly constraints to successfully construct a multipart object.
5.3.6. Utilize part libraries effectively during the assembly modeling process.
5.3.7. Employ subassemblies during the production of assemblies.
5.3.8. Verify drive constraints that simulate the motion of parts in assemblies.
5.3.9. Apply adaptive design concepts during the development of sketches, features, parts, and assemblies.
5.3.10. Translate a three-dimensional drawing or model into corresponding orthographic drawing views.
5.3.11. Evaluate the accuracy of mass properties calculations.
5.3.12. Evaluate a model for design imperfections.

An “X” indicates that the pathway applies to the outcome.
Outcome: 5.4. Computer-Aided Drafting:
I CAN… Interpret and prepare technical drawings.

Competencies
5.4.1. Create and interpret auxiliary views, orthographic projections, isometric drawings, oblique drawings and perspective drawings.
5.4.2. Create a sectional view drawing.
5.4.3. Illustrate the types of breaks and symbols used in drawing sectional views.
5.4.4. Produce a reverse-engineered drawing from a solid object.
5.4.5. Add technical elements (e.g., parts lists, titles, finishes, tolerances, specifications, hidden surfaces) to drawings.

An “X” indicates that the pathway applies to the outcome.

Outcome: 5.6 Production and Process Design:
I CAN… Plan, set up, monitor, analyze, and control integrated systems.

Competencies
5.6.1 Identify the planning and process procedures for production (e.g., corrective preventive actions, audit documentation, Process Failure Mode Effect Analysis [PFMEA]).
5.6.2 Use process planning and improvement tools (e.g., flowcharts, diagrams, design for manufacturability [DFM]).
5.6.3 Employ project scheduling techniques (e.g., critical path methodology [CPM], project evaluation and review technique [PERT]).
5.6.4 Identify criteria and constraints and determine how those will affect the design of the production process.
5.6.5 Estimate time, tooling, product packaging, and material costs.
5.6.6 Monitor performance against time, tool, and material cost estimates.
5.6.7 Set capacity to account for fluctuation in demand.
5.6.8 Adjust the plan as necessary to respond to variations (e.g., process, demand, material).
5.6.9 Evaluate final solutions and communicate observations, processes, and results.
5.6.10 Develop a packaging design that prepares a product for shipping.
Precision Machine Tool concepts will be introduced through a series of instructional videos.

**Strand 6. Precision Machining**
Learners apply principles of precision machining to measuring work pieces, drawing interpretation, inspection, bench work and layout, power saws, drilling machines, lathes and turning machines, milling machines and grinding machines.

**Outcome: 6.1. Measurement and Interpretation:**
I CAN… Interpret drawings and documentation and perform measurements.

**Competencies**
6.1.1. Identify measuring tools and gradations used in precision machining and their purposes.
6.1.2. Identify typical measurements in precision machining (e.g., angles, diameter, distance).
6.1.3. Identify measuring systems and convert between systems.
6.1.4. Measure and inspect work pieces according to product specifications.
6.1.5. Identify information and symbols typically provided in drawings and specifications.

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Outcome: 6.2. Layout and Planning:
I CAN… Plan a machining process.

**Competencies**
6.2.1. Determine product requirements, dimensions, and tolerances from drawing and specifications.

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SCOPE AND SEQUENCE
DIGITAL ELECTRONICS
175007

Course Description:
Students are introduced to the process of combinational and sequential logic design. The system uses a precise sequence of discrete voltages, representing numbers, non-numeric symbols or commands for input, processing, transmission, storage, or display. Engineering standards and methods for technical documentation will also be learned.
SCOPE AND SEQUENCE
DIGITAL ELECTRONICS
WESTSHORE CAREER AND TECHNICAL EDUCATION DISTRICT

Employability skill are taught extensively in the Senior Capstone course however review, retaught and test for competency in this course.

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

Outcome: 1.1. Employability Skills:
I CAN… Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

Competencies
1.1.1. Identify the knowledge, skills, and abilities necessary to succeed in careers.
1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.

1.1.3. Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options.

1.1.4. Describe the role and function of professional organizations, industry associations, and organized labor and use networking techniques to develop and maintain professional relationships.

1.1.5. Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, résumé writing, interviewing skills, portfolio development).

1.1.6. Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles.

1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.

1.1.8. Identify the correlation between emotions, behavior, and appearance and manage those to establish and maintain professionalism.

1.1.9. Give and receive constructive feedback to improve work habits.

1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.

1.1.11. Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them.

1.1.12. Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits, and abusive behavior.

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Outcome: 1.2. Leadership and Communications:
I CAN… Process, maintain, evaluate, and disseminate information in a business. Develop leadership and team building to promote collaboration.

Competencies
1.2.1. Extract relevant, valid information from materials and cite sources of information.
1.2.2. Deliver formal and informal presentations.
1.2.3. Identify and use verbal, nonverbal, and active listening skills to communicate effectively.
1.2.4. Use negotiation and conflict-resolution skills to reach solutions.
1.2.5. Communicate information (e.g., directions, ideas, vision, workplace expectations) for an intended audience and purpose.
1.2.6. Use proper grammar and expression in all aspects of communication.
1.2.7. Use problem-solving and consensus-building techniques to draw conclusions and determine next steps.
1.2.8. Identify the strengths, weaknesses, and characteristics of leadership styles that influence internal and external workplace relationships.
1.2.9. Identify advantages and disadvantages involving digital and/or electronic communications (e.g., common content for large audience, control of tone, speed, cost, lack of non-verbal cues, potential for forwarding information, longevity).

1.2.10. Use interpersonal skills to provide group leadership, promote collaboration, and work in a team.

1.2.11. Write professional correspondence, documents, job applications, and résumés.

1.2.12. Use technical writing skills to complete forms and create reports.

1.2.13. Identify stakeholders and solicit their opinions.

1.2.14. Use motivational strategies to accomplish goals.

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Outcome: 1.3. Business Ethics and Law:

I CAN... Analyze how professional, ethical, and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

Competencies

1.3.1. Analyze how regulatory compliance affects business operations and organizational performance.

1.3.2. Follow protocols and practices necessary to maintain a clean, safe, and healthy work environment.

1.3.3. Use ethical character traits consistent with workplace standards (e.g., honesty, personal integrity, compassion, justice).

1.3.4. Identify how federal and state consumer protection laws affect products and services.

1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], U.S. Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

1.3.6. Identify deceptive practices (e.g., bait and switch, identity theft, unlawful door-to-door sales, deceptive service estimates, fraudulent misrepresentations) and their overall impact on organizational performance.

1.3.7. Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g., harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act, Fair Labor Standards Acts, Equal Employment Opportunity Commission).

1.3.8. Verify compliance with computer, copyright, and intellectual property laws and regulations.

1.3.9. Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal, organizational, and professional ethical standards.

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**Outcome: 1.4. Knowledge Management and Information Technology:**

I CAN… Demonstrate current and emerging strategies and technologies used to collect, analyze, record, and share information in business operations.

**Competencies**

1.4.1. Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems).
1.4.2. Select and use software applications to locate, record, analyze, and present information (e.g., word processing, electronic mail, spreadsheet, databases, presentation, Internet search engines).
1.4.3. Verify compliance with security rules, regulations, and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to industry pathway.
1.4.4. Use system hardware to support software applications.
1.4.5. Use information technology tools to maintain, secure, and monitor business records.
1.4.6. Use electronic database to access and create business and technical information.
1.4.7. Use personal information management and productivity applications to optimize assigned tasks (e.g., lists, calendars, address books).
1.4.8. Use electronic media to communicate and follow network etiquette guidelines.

*An “X” indicates that the pathway applies to the outcome.*

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**Outcome: 1.5. Global Environment:**

I CAN… Evaluate how beliefs, values, attitudes, and behaviors influence organizational strategies and goals.

**Competencies**

1.5.1. Describe how cultural understanding, cultural intelligence skills, and continual awareness are interdependent.
1.5.2. Describe how cultural intelligence skills influence the overall success and survival of an organization.
1.5.3. Use cultural intelligence to interact with individuals from diverse cultural settings.
1.5.4. Recognize barriers in cross-cultural relationships and implement behavioral adjustments.
1.5.5. Recognize the ways in which bias and discrimination may influence productivity and profitability.
1.5.6. Analyze work tasks for understanding and interpretation from a different cultural perspective.
1.5.7. Use intercultural communication skills to exchange ideas and create meaning.
1.5.8. Identify how multicultural teaming and globalization can foster development of new and improved products and services and recognition of new opportunities.

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**Outcome: 1.6. Business Literacy:**

I CAN... Develop foundational skills and knowledge in entrepreneurship, financial literacy, and business operations.

**Competencies**
1.6.1. Identify business opportunities.
1.6.2. Assess the reality of becoming an entrepreneur, including advantages and disadvantages (e.g., risk vs. reward, reasons for success and failure).
1.6.3. Explain the importance of planning your business.
1.6.4. Identify types of businesses, ownership, and entities (i.e., individual proprietorships, partnerships, corporations, cooperatives, public, private, profit, not-for-profit).
1.6.5. Describe organizational structure, chain of command, the roles and responsibilities of the organizational departments, and interdepartmental interactions.
1.6.6. Identify the target market served by the organization, the niche that the organization fills, and outlook of the industry.
1.6.7. Identify the effect of supply and demand on products and services.
1.6.8. Identify the features and benefits that make an organization’s product or service competitive.
1.6.9. Explain how the performance of an employee, a department, and an organization is assessed.
1.6.10. Describe the impact of globalization on an enterprise or organization.
1.6.11. Describe how all business activities of an organization work within the parameters of a budget.
1.6.12. Describe classifications of employee benefits, rights, deductions, and compensations.

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**Outcome: 1.9. Financial Management:**

I CAN... Use financial tools, strategies, and systems to develop, monitor, and control the use of financial resources to ensure personal and business financial well-being.

**Competencies**
1.9.1. Create, analyze, and interpret financial documents (e.g., budgets, income statements).
1.9.2. Identify tax obligations
1.9.3. Review and summarize savings, investment strategies, and purchasing options (e.g., cash, lease, finance, stocks, bonds).
1.9.4. Identify credit types and their uses in order to establish credit.
1.9.5. Identify ways to avoid or correct debt problems.
1.9.6. Explain how credit ratings and the criteria lenders use to evaluate repayment capacity affect access to loans.
1.9.7. Review and summarize categories (types) of insurance and identify how insurances can reduce financial risk.
1.9.8. Identify income sources and expenditures.
1.9.9. Compare and contrast different banking services available through financial institutions.
1.9.10. Identify the role of depreciation in tax planning and liability.

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**Standard 0.1: I CAN….Choose ethical courses of action in all work assignments and personal interactions**

0.1.1 Establish a personal code of ethics
0.1.2 Ensure that personal code of ethics is consistent with the professional code of ethics of the chosen profession
0.1.3 Identify strategies that strengthen desirable character traits (including honesty, integrity, compassion, empathy, justice)
0.1.4 Identify consequences of unethical conduct
0.1.5 Recognize conflict between personal/professional ethics and the ethics of others
0.1.6 Demonstrate awareness of legal responsibilities (e.g., copyright laws, harassment, equity)
0.1.7 Identify strategies for responding to the unethical actions of individuals and organizations

**Standard 0.2: I CAN… Implement safety procedures and programs**

0.2.1 Identify safety requirements
0.2.2 Demonstrate knowledge of safety rules and guidelines
0.2.3 Interpret safety signs and symbols
0.2.4 Demonstrate desirable safety attitudes and habits
0.2.5 Use safety equipment in accordance with established procedures
0.2.6 Document results of safety procedures and programs

**Strand 2. Electrical/Electronics**

Learners apply principles of electricity and electronics related to electronic theory, alternating and direct current, electronic components, electronic skills, digital electronics and power supplies. Knowledge and skills may be applied to fundamentals of electricity, analyzing and evaluating circuits, assembling components into electrical circuits, creating circuits to perform tasks and
operations, wiring components to construct a communications system and providing power to an electrical system.

**Outcome: 2.1 Electronic Theory:**
I CAN… Explain electrical principles and theories.

**Competencies**
2.1.1 Describe the structure of atoms and their relationship to electricity.
2.1.2 Compare and contrast electrical and electromagnetic effect.
2.1.3 Explain methods of producing electrical current.
2.1.4 Explain how batteries store and disperse energy.
2.1.5 Compare and contrast alternating current (AC) and direct current (DC).
2.1.6 Define the units of measurement for voltage, current, power, and resistance.
2.1.7 Describe the relationships between voltage, current, resistance, and power in circuits.
2.1.8 Determine voltage, current, resistance, and power in circuits using Ohm’s Law, Kirchhoff’s Law, and Watt’s Law.
2.1.9 Describe the purpose of grounding and common methods used for grounding.
2.1.10 Evaluate frequency and phase.
2.1.11 Identify methods of varying capacitance.
2.1.12 Calculate true power, apparent power, reactive power, and power factor.
2.1.13 Determine impedance.
2.1.14 Compare peak (PK), root mean square (RMS), and average values.

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**Outcome: 2.2. Circuits:**
I CAN… Construct and analyze alternating current (AC) circuits and direct current (DC) circuits.

**Competencies**
2.2.1 Compare and contrast conductors and insulators.
2.2.2 Identify common types of transformers and list uses for each.
2.2.3 Explain step up/step down voltage methods.
2.2.4 Describe lamination and explain why laminations are used.
2.2.5 Identify types of capacitors and common usages for each.
2.2.6 Identify types of inductors and explain the purposes of different core materials.
2.2.7 Identify the function of inductors and capacitors in series and parallel circuits.
2.2.8 Explain the uses of series, parallel, and series-parallel circuits.
2.2.9 Construct and troubleshoot series, parallel, and series-parallel circuits.
2.2.10 Analyze wiring schematics and diagrams for accuracy and function.

An “X” indicates that the pathway applies to the outcome.
Outcome: 2.4. Electronic Components:
I CAN... Describe electronic components and their functions and purpose.

Competencies

2.4.1. Identify resistor values from color codes or other marks.
2.4.2. Compare and contrast resistor compositions and their uses.
2.4.3. Identify symbols for electronic components.
2.4.4. Compare and contrast negative positive negative (NPN) and positive negative positive (PNP) transistors.
2.4.5. Identify types of transistors and explain their uses (i.e., Darlington pairs, unijunction transistors, Gunn diodes, field effect transistors [FETs] and metal-oxide semiconductor field-effect transistor [MOSFETs], N- and P- channel junction field effect transistors [JFETs]).
2.4.6. Compare and contrast the purpose and function of thyristors (diacs, triacs, varisters, and thermistors).
2.4.7. Describe the purpose and operation of zener diodes.
2.4.8. Describe the purpose and operation of common optical devices (e.g., light emitting diodes [LEDs], liquid crystal displays [LCDs]).
2.4.9. Describe the purpose and operation of photovoltaic cells.
2.4.10. Describe the purpose, composition, and operation of photo resistors, photodiodes, and phototransistors.
2.4.11. Define surface mount components.
2.4.12. Describe the purpose and operation of audio amplifiers and their frequency response.
2.4.13. Explain the purpose and operation of common emitter (CE) amplifiers, common base (CB) amplifiers, and common collector (CC) or emitter follower amplifiers.

An “X” indicates that the pathway applies to the outcome.

Outcome: 2.6. Digital Electronics:
I CAN... Create circuits to perform tasks and operations.

Competencies

2.6.1. Determine output frequency of circuits.
2.6.2. Describe the purpose and use of logic gates (e.g., discrete and medium scale integration [MSI] gates, latches, flip-flops).
2.6.3. Design a paradigm for combinational logic circuits (i.e., encoders, decoders, multiplexers, demultiplexers, adders, subtractors, ALUs). *(Updated 28 AUG 2014)*

2.6.4. Design a specific MSI gate application.

2.6.5. Describe the purpose and operation of programmable logic devices (PLDs) and complex programmable logic devices (CPLDs).

2.6.6. Describe the purpose and use of asynchronous and synchronous counters.

2.6.7. Determine fan-out and propagation delays.

2.6.8. Explain the purpose and use of a digital bus.

2.6.9. Explain the purpose and use of pulsers and logic probes.

2.6.10. Identify the numbering systems, codes, arithmetic operations, Boolean operations, and simplification methods used in digital electronics.

2.6.11. Describe the purpose and use of digital-to-analog and analog-to-digital circuits.


2.6.13. Utilize counters and shift registers in a circuit. *(Updated 28 AUG 2014)*


2.6.15. Construct a digital circuit based on the schematic using solder and solderless techniques.

2.6.16. Test circuit function.

2.6.17. Use schematics and test points to locate subsystem, component, and wiring failures in electronics products.

2.6.18. Use the Boolean Algebra laws and DeMorgan’s Theorem in the simplification of logic circuits. *(Updated 28 AUG 2014)*

An “X” indicates that the pathway applies to the outcome.

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**Outcome: 2.8 Power Supplies:** Provide power to electrical circuits.

**Competencies**

2.8.1 Identify the differences between transformer-powered supplies and line-connected supplies.

2.8.2 Select a battery based on composition, environment, and circuit characteristics.

2.8.3 Select and install filters.

2.8.4 Construct and install regulated power supplies.

2.8.5 Select and install fuses and circuit breakers.

2.8.6 Select and construct half-wave, full wave, and bridge rectifiers.

2.8.7 Select and install power conditioning, isolation transformers, surge suppressors, and uninterruptible power supplies.

An “X” indicates that the pathway applies to the outcome.
The capstone course provides opportunities for students to apply knowledge, attitudes and skills that were learned in Engineering program in a more comprehensive and authentic way. Capstones often include project/problem based learning opportunities that occur both in and away from school. Under supervision of the school and through community partnerships, students may combine classroom learning with work experience. This course can be delivered through a variety of delivery methods including cooperative education or apprenticeship.

Strand 1. **Business Operations/21st Century Skills**
Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome: 1.1. Employability Skills:**
I CAN… Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**
1.1.1. Identify the knowledge, skills, and abilities necessary to succeed in careers.
1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.
1.1.3. Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options.
1.1.4. Describe the role and function of professional organizations, industry associations, and organized labor and use networking techniques to develop and maintain professional relationships.
1.1.5. Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, résumé writing, interviewing skills, portfolio development).
1.1.6. Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles.
1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.
1.1.8. Identify the correlation between emotions, behavior, and appearance and manage those to establish and maintain professionalism.
1.1.9. Give and receive constructive feedback to improve work habits.
1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.
1.1.11. Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them.
1.1.12. Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits, and abusive behavior.

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Outcome: 1.2. Leadership and Communications:
I CAN… Process, maintain, evaluate, and disseminate information in a business. Develop leadership and team building to promote collaboration.

Competencies
1.2.1. Extract relevant, valid information from materials and cite sources of information.
1.2.2. Deliver formal and informal presentations.
1.2.3. Identify and use verbal, nonverbal, and active listening skills to communicate effectively.
1.2.4. Use negotiation and conflict-resolution skills to reach solutions.
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Outcome: 1.3. Business Ethics and Law:
I CAN... Analyze how professional, ethical, and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

Competencies
1.3.1. Analyze how regulatory compliance affects business operations and organizational performance.
1.3.2. Follow protocols and practices necessary to maintain a clean, safe, and healthy work environment.
1.3.3. Use ethical character traits consistent with workplace standards (e.g., honesty, personal integrity, compassion, justice).
1.3.4. Identify how federal and state consumer protection laws affect products and services.
1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], U.S. Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.
1.3.6. Identify deceptive practices (e.g., bait and switch, identity theft, unlawful door-to-door sales, deceptive service estimates, fraudulent misrepresentations) and their overall impact on organizational performance.
1.3.7. Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g., harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act, Fair Labor Standards Acts, Equal Employment Opportunity Commission).
1.3.8. Verify compliance with computer, copyright, and intellectual property laws and regulations.
1.3.9. Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal, organizational, and professional ethical standards.

An “X” indicates that the pathway applies to the outcome.

Outcome: 1.4. Knowledge Management and Information Technology:
I CAN... Demonstrate current and emerging strategies and technologies used to collect, analyze, record, and share information in business operations.

Competencies
1.4.1. Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems).
1.4.2. Select and use software applications to locate, record, analyze, and present information (e.g., word processing, electronic mail, spreadsheet, databases, presentation, Internet search engines).

1.4.3. Verify compliance with security rules, regulations, and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to industry pathway.

1.4.4. Use system hardware to support software applications.

1.4.5. Use information technology tools to maintain, secure, and monitor business records.

1.4.6. Use electronic database to access and create business and technical information.

1.4.7. Use personal information management and productivity applications to optimize assigned tasks (e.g., lists, calendars, address books).

1.4.8. Use electronic media to communicate and follow network etiquette guidelines.

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Outcome: 1.5. Global Environment:

I CAN… Evaluate how beliefs, values, attitudes, and behaviors influence organizational strategies and goals.

Competencies

1.5.1. Describe how cultural understanding, cultural intelligence skills, and continual awareness are interdependent.

1.5.2. Describe how cultural intelligence skills influence the overall success and survival of an organization.

1.5.3. Use cultural intelligence to interact with individuals from diverse cultural settings.

1.5.4. Recognize barriers in cross-cultural relationships and implement behavioral adjustments.

1.5.5. Recognize the ways in which bias and discrimination may influence productivity and profitability.

1.5.6. Analyze work tasks for understanding and interpretation from a different cultural perspective.

1.5.7. Use intercultural communication skills to exchange ideas and create meaning.

1.5.8. Identify how multicultural teaming and globalization can foster development of new and improved products and services and recognition of new opportunities.

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Outcome: 1.6. Business Literacy:
I CAN... Develop foundational skills and knowledge in entrepreneurship, financial literacy, and business operations.

Competencies
1.6.1. Identify business opportunities.
1.6.2. Assess the reality of becoming an entrepreneur, including advantages and disadvantages (e.g., risk vs. reward, reasons for success and failure).
1.6.3. Explain the importance of planning your business.
1.6.4. Identify types of businesses, ownership, and entities (i.e., individual proprietorships, partnerships, corporations, cooperatives, public, private, profit, not-for-profit).
1.6.5. Describe organizational structure, chain of command, the roles and responsibilities of the organizational departments, and interdepartmental interactions.
1.6.6. Identify the target market served by the organization, the niche that the organization fills, and outlook of the industry.
1.6.7. Identify the effect of supply and demand on products and services.
1.6.8. Identify the features and benefits that make an organization’s product or service competitive.
1.6.9. Explain how the performance of an employee, a department, and an organization is assessed.
1.6.10. Describe the impact of globalization on an enterprise or organization.
1.6.11. Describe how all business activities of an organization work within the parameters of a budget.
1.6.12. Describe classifications of employee benefits, rights, deductions, and compensations.

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Outcome: 1.9. Financial Management:
I CAN... Use financial tools, strategies, and systems to develop, monitor, and control the use of financial resources to ensure personal and business financial well-being.

Competencies
1.9.1. Create, analyze, and interpret financial documents (e.g., budgets, income statements).
1.9.2. Identify tax obligations
1.9.3. Review and summarize savings, investment strategies, and purchasing options (e.g., cash, lease, finance, stocks, bonds).
1.9.4. Identify credit types and their uses in order to establish credit.
1.9.5. Identify ways to avoid or correct debt problems.
1.9.6. Explain how credit ratings and the criteria lenders use to evaluate repayment capacity affect access to loans.

1.9.7. Review and summarize categories (types) of insurance and identify how insurances can reduce financial risk.

1.9.8. Identify income sources and expenditures.

1.9.9. Compare and contrast different banking services available through financial institutions.

1.9.10. Identify the role of depreciation in tax planning and liability.

An “X” indicates that the pathway applies to the outcome.

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**Standard 0.1: I CAN….choose ethical courses of action in all work assignments and personal interactions**

0.1.1 Establish a personal code of ethics
0.1.2 Ensure that personal code of ethics is consistent with the professional code of ethics of the chosen profession
0.1.3 Identify strategies that strengthen desirable character traits (including honesty, integrity, compassion, empathy, justice)
0.1.4 Identify consequences of unethical conduct
0.1.5 Recognize conflict between personal/professional ethics and the ethics of others
0.1.6 Demonstrate awareness of legal responsibilities (e.g., copyright laws, harassment, equity)
0.1.7 Identify strategies for responding to the unethical actions of individuals and organizations

**Standard 0.2: I CAN Implement safety procedures and programs**

0.2.1 Identify safety requirements
0.2.2 Demonstrate knowledge of safety rules and guidelines
0.2.3 Interpret safety signs and symbols
0.2.4 Demonstrate desirable safety attitudes and habits
0.2.5 Use safety equipment in accordance with established procedures
0.2.6 Document results of safety procedures and programs

All students enrolled in the pre-engineering program must satisfy the requirements of this capstone project.

**Engineering Design and Development**

Unit 1: Course Introduction and Justification

**Time Days: 17 days**

Lesson 1.1: Introduction to Engineering Design and Development™ (17 days):
Concepts Addressed in Lesson:

1. An informed decision-making process is a valuable tool in solving a problem.
2. The ability to use technical and expository writing is an essential skill of communication.
3. Technical writing involves communicating a problem and its potential solution to a particular audience.
4. The use of expository writing provides the reader with facts about a subject in an informative style.
5. Good project management will ensure the success of a project.
6. A design process most used by engineers includes defining a problem, brainstorming, researching, identifying requirements, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype, testing, refining, making, and communicating results.
7. A designer uses an engineer’s notebook to chronologically document all aspects of a design project.

Unit 2: Problem Identification

**Time Days: 30 days**

Lesson 2.1: Introduction to Problem Statement *(9 days):*

Concepts Addressed in Lesson:

1. Brainstorming is an effective technique used to generate problem statements to identified problems.
2. Writing a concise problem statement is the foundation in solving problems.
3. An accurately written problem statement aids in determining if the result of the engineering design and development process has solved the identified problem.

Lesson 2.2: Verify and Justify the Problem *(21 days):*

Concepts Addressed in Lesson:

1. An accurately written problem statement identifies a need and guides the design process that will be used in engineering design problems.
2. Experts are professionals that guide the research needed for accurate justification and solutions to design problems.
Unit 3: Research

Time Days: 15 days

Lesson 3.1: Research and Development (3 days):

Concepts Addressed in Lesson:

1. Research refers to the advancement of knowledge and development refers to the application of knowledge.
2. Market research aids business and industry in making better decisions about the development and marketing of new products.

Lesson 3.2: Investigate Current and Past Solutions (6 days):

Concepts Addressed in Lesson:

1. A patent is a legally binding agreement between an inventor, owner, and the people of the United States that grants the exclusive right to produce and sell an invention or innovation for a certain length of time.
2. Securing a patent involves a series of steps that must be followed.
3. Research is used to investigate what solutions exist to a technical problem and if an innovation or new invention is warranted.

Lesson 3.3: Invent or Innovate (6 days):

Concepts Addressed in Lesson:

1. Engineers design solutions to technical problems that may be an invention, something new, or they may be an innovation, a modification of an already existing solution.
2. Inventions and innovations are the results of specific, goal-directed research.
3. Creative thinking and economic and cultural influences shape the development of solutions to technical problems.
4. The use of assessment techniques, such as trend analysis provide information to determine if a solution should be pursued to design and development.

Unit 4: Decision Process

Time Days: 8 days

Lesson 4.1: Defining Product Specifications (8 days):
Concepts Addressed in Lesson:

1. Specifications for a design solution enhance creativity by identifying the criteria and constraints of the design process.
2. Engineers use a decision matrix to evaluate the preliminary design solution by implementing multiple parameters.
3. The use of optimization improves the final design solution by justifying the specifications applied.

Unit 5: Design

**Time Days: 20 days**

Lesson 5.1: Sketching and Technical Drawings (20 days):

Concepts Addressed in Lesson:

1. The use of symbols and drawings promotes clear communication of a design solution.
2. Drawings and sketches are used to organize, record, and communicate ideas to experts.
3. Engineers use working drawings to show all the information needed to make a single part, subassembly, or a complete design solution.
4. Technical drawings are used to evaluate design solutions for any necessary refinements.

Unit 6: Build

**Time Days: 35 days**

Lesson 6.1: Building a Prototype (35 days):

Concepts Addressed in Lesson:

1. The use of tool machine safety allows engineers to prevent accidents during the construction of the prototype.
2. Engineers write step-by-step instructions for the prototype assembly to guide the fabrication of the design solution.
3. Availability of materials and equipment is determined by using a materials and cost analysis during the prototyping phase of a project.
4. Prototyping provides the engineer with a scaled working model of the design solution.
Unit 7: Test

Time Days: 24 days

Lesson 7.1: Test Method (6 days):

Concepts Addressed in Lesson:

1. Specific criteria for success or failure of a test must be determined before testing commences.
2. Prototype testing is a controlled procedure that is used to evaluate a specific aspect of a design solution.
3. The results of prototype testing are used to refine the design and to improve the design solution.

Lesson 7.2: Test Designed Solution (18 days):

Concepts Addressed in Lesson:

1. Engineers write a detailed description of the testing procedure to ensure the testing of the design solution is valid.
2. Evaluation of the test results allows engineers to determine if the test is accurate and repeatable.

Unit 8: Presentation

Time Days: 26 days

Lesson 8.1: Project Documentation (17 days):

Concepts Addressed in Lesson:

1. The use of PowerPoint® allows engineers to present visual aids and project information in a professional manner.
2. Engineers use a technical report to provide thorough communication of all aspects of a design solution.
3. Various media formats are chosen to effectively communicate the design solution process to a target audience.

Lesson 8.2: Juried Presentation (9 days):

Concepts Addressed in Lesson:
1. Engineers develop skills in public speaking to effectively communicate their design solutions.

2. Computerized visual presentations are used to emphasize the content of the engineer’s design process.

3. Presentations and displays of work provide the means to effectively promote the implementation of a project.

4. A well-done presentation will enhance the quality work of a team’s project.

5. Resumes are used by engineers to promote their knowledge and skills when searching for employment.

**Total days: 175 Days**

**Scope and Sequence**

Robotics

Subject Code: 175004
Students will apply the knowledge and skills necessary to program and operate Robots, using the teach pendant as the main interface point. The Students will learn robotic operations and system configurations. Students will code, compile, and debug programs using the robotic programming language.

Scope and Sequence
Robotics

**Strand 1. Business Operations/21st Century Skills**
Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome: 1.1. Employability Skills:**
**I Can:** Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**
1.1.1. Identify the knowledge, skills, and abilities necessary to succeed in careers.
1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.
1.1.7. Apply problem solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.
1.1.9. Give and receive constructive feedback to improve work habits.

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**Outcome: 1.2. Leadership and Communications:**

**I Can:** Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**
1.2.1. Extract relevant, valid information from materials and cite sources of information.
1.2.2. Deliver formal and informal presentations.
1.2.4. Use negotiation and conflict-resolution skills to reach solutions.
1.2.5. Communicate information (e.g., directions, ideas, vision, workplace expectations) for an intended audience and purpose.
1.2.6. Use proper grammar and expression in all aspects of communication.
1.2.7. Use problem-solving and consensus-building techniques to draw conclusions and determine next steps.
1.2.8. Identify the strengths, weaknesses, and characteristics of leadership styles that influence internal and external workplace relationships.
1.2.12. Use technical writing skills to complete forms and create reports.
1.2.13. Identify stakeholders and solicit their opinions.
1.2.14. Use motivational strategies to accomplish goals.

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**Outcome: 1.3. Business Ethics and Law:**

**I Can:** Analyze how professional, ethical, and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.
Competencies
1.3.2. Follow protocols and practices necessary to maintain a clean, safe, and healthy work environment.

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Standard 0.1: I CAN….Choose ethical courses of action in all work assignments and personal interactions

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0.2.1 Identify safety requirements
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0.2.3 Interpret safety signs and symbols
0.2.4 Demonstrate desirable safety attitudes and habits
0.2.5 Use safety equipment in accordance with established procedures
0.2.6 Document results of safety procedures and programs

Outcome: 1.4. Knowledge Management and Information Technology:

I Can: Demonstrate current and emerging strategies and technologies used to collect, analyze, record, and share information in business operations.

Competencies
1.4.1. Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems).
1.4.2. Select and use software applications to locate, record, analyze, and present information (e.g., word processing, electronic mail, spreadsheet, databases, presentation, Internet search engines).
1.4.4. Use system hardware to support software applications.
1.4.5. Use information technology tools to maintain, secure, and monitor business records.

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Outcome: 1.5. Global Environment:

**I Can:** Demonstrate current and emerging strategies and technologies used to collect, analyze, record, and share information in business operations.

**Competencies**
1.5.1. Describe how cultural understanding, cultural intelligence skills, and continual awareness are interdependent.
1.5.2. Describe how cultural intelligence skills influence the overall success and survival of an organization.
1.5.3. Use cultural intelligence to interact with individuals from diverse cultural settings.
1.5.4. Recognize barriers in cross-cultural relationships and implement behavioral adjustments.
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1.5.8. Identify how multicultural teaming and globalization can foster development of new and improved products and services and recognition of new opportunities.

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Outcome: 1.6. Business Literacy:

**I Can:** Develop foundational skills and knowledge in entrepreneurship, financial literacy, and business operations.

**Competencies**
1.6.1. Identify business opportunities.
1.6.5. Describe organizational structure, chain of command, the roles and responsibilities of the organizational departments, and interdepartmental interactions.
1.6.7. Identify the effect of supply and demand on products and services.
1.6.8. Identify the features and benefits that make an organization’s product or service competitive.
1.6.9. Explain how the performance of an employee, a department, and an organization is assessed.
1.6.10. Describe the impact of globalization on an enterprise or organization.
1.6.11. Describe how all business activities of an organization work within the parameters of a budget.

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Outcome: 1.9. Financial Management:
I Can: Use financial tools, strategies, and systems to develop, monitor, and control the use of financial resources to ensure personal and business financial well-being.

Competencies
1.9.4. Identify credit types and their uses in order to establish credit.
1.9.5. Identify ways to avoid or correct debt problems.
1.9.6. Explain how credit ratings and the criteria lenders use to evaluate repayment capacity affect access to loans.
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Strand 2. Electrical/Electronics
Learners apply principles of electricity and electronics related to electronic theory, alternating and direct current, electronic components, electronic skills, digital electronics and power supplies. Knowledge and skills may be applied to fundamentals of electricity, analyzing and evaluating circuits, assembling components into electrical circuits, creating circuits to perform tasks and operations, wiring components to construct a communications system and providing power to an electrical system.

Outcome: 2.1 Electronic Theory:

I Can: Explain electrical principles and theories.

Competencies
2.1.1. Describe the structure of atoms and their relationship to electricity.
2.1.2. Compare and contrast electrical and electromagnetic effect.
2.1.3. Explain methods of producing electrical current.
2.1.4. Explain how batteries store and disperse energy.
2.1.5. Compare and contrast alternating current (AC) and direct current (DC).
2.1.6. Define the units of measurement for voltage, current, power, and resistance.
2.1.7. Describe the relationships between voltage, current, resistance, and power in circuits.
2.1.8. Determine voltage, current, resistance, and power in circuits using Ohm’s Law, Kirchhoff’s Law, and Watt’s Law.
2.1.9. Describe the purpose of grounding and common methods used for grounding.
2.1.10. Evaluate frequency and phase.
2.1.11. Identify methods of varying capacitance.
2.1.12. Calculate true power, apparent power, reactive power, and power factor.
2.1.14. Compare peak (PK), root mean square (RMS), and average values.

An “X” indicates that the pathway applies to the outcome.
Outcome: 2.2. Circuits:

I Can: Construct and analyze alternating current (AC) circuits and direct current (DC) circuits.

Competencies
2.2.8 Explain the uses of series, parallel, and series-parallel circuits.
2.2.9 Construct and troubleshoot series, parallel, and series-parallel circuits.
2.2.10 Analyze wiring schematics and diagrams for accuracy and function.

Outcome: 2.6 Digital Electronics:

I Can: Create circuits to perform tasks and operations.

Competencies
2.6.5 Describe the purpose and operation of programmable logic devices (PLDs) and complex programmable logic devices (CPLDs).
2.6.6 Describe the purpose and use of asynchronous and synchronous counters.
2.6.8 Explain the purpose and use of a digital bus.
2.6.10 Identify the numbering systems, codes, arithmetic operations, Boolean operations, and simplification methods used in digital electronics.

Outcome: 2.7 Cabling and Wiring: Connect components to construct low-voltage, data, and communication systems using coaxial or fiber optic cables and twisted pair or balanced wires.

I Can: Create circuits to perform tasks and operations.

Competencies
2.7.1 Describe the types, purposes, and uses of cables and wires.
2.7.2 Identify the construction, impedance characteristics, and use of cables and wires.
2.7.3 Explain how the characteristics of cables and wires cause impedance.
2.7.4. Select methods for splicing and terminating cables and wires.
2.7.5. Splice and terminate cables and wires.
2.7.6. Test cables and wires.

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Outcome: 2.8 Power Supplies:

**I Can:** Provide power to electrical circuits.

Competencies

2.8.1 Identify the differences between transformer-powered supplies and line-connected supplies.
2.8.2 Select a battery based on composition, environment, and circuit characteristics.

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Strand 3. Computer Integrated Manufacturing
Learners apply the principles of computer integrated manufacturing related to computer numerical control, robotics, programmable logic controllers and power systems.

Outcome: 3.2 Robotics:

**I Can:** Plan and operate robotics production processes.

Competencies

3.2.1 Identify the components of a robot system and explain their roles in the robot’s operation cycle.
3.2.2 Maintain robot components and controllers.
3.2.3 Use the robotic systems classification scheme to select an industrial robot.
3.2.4 Use job specifications to create programs for robot operations, sensors, and feeder systems.
3.2.5 Plan, program, and test a robotic work cell using teach pendant and simulation software.
3.2.6. Identify the robot’s payload and identify the concepts of payload weight, moment, and inertia to select an appropriate robot.

3.2.7. Use robot speed specifications to calculate estimated cycle times for sample tasks.

3.2.8. Identify home position (fixed and floating zero) using absolute and incremental coordinates.

3.2.9. Compare and contrast various robotic applications and processes (e.g., pick and place, welding).

3.2.10. Identify the robot’s work envelope and apply the concepts of reach and articulation to evaluate whether a robot is suited to an application.

3.2.11. Analyze the performance and troubleshoot the operation of a robotic cell.

An “X” indicates that the pathway applies to the outcome.

<table>
<thead>
<tr>
<th>Pathways</th>
<th>X</th>
<th>Operations</th>
<th>X</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Practices</td>
<td>Green-specific</td>
<td>Context-dependent</td>
<td>X</td>
<td>Does not apply</td>
</tr>
</tbody>
</table>

Outcome: 3.3. Programmable Logic Controllers (PLCs):

I Can: Program digital computers used for automation of electromechanical processes to perform tasks.

Competencies

3.3.1. Identify PLCs.

3.3.2. Design a PLC program using timers, counters, and sequencers. *(Updated 28 AUG 2014)*

3.3.3. Describe the use of PLCs in manufacturing automation.

3.3.4. Apply and execute ladder logic programs. *(Updated 28 AUG 2014)*

3.3.5. Design a motor control program using manual and automatic modes.

3.3.6. Monitor and troubleshoot a hard-wired system with a PLC.

3.3.7. Monitor PLC operation using systems control dialog.

An “X” indicates that the pathway applies to the outcome.

<table>
<thead>
<tr>
<th>Pathways</th>
<th>X</th>
<th>Operations</th>
<th>X</th>
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<td>Green Practices</td>
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</tr>
</tbody>
</table>

These items (listed below), though listed in ODE, are not specifically covered in Robotics. However, the other four class requirements, including Introduction to Design, Principles of Engineering, Digital Electronic, and the Capstone project, weave the following omitted items into their curriculum:

1.1.3. Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options.

1.1.4. Describe the role and function of professional organizations, industry associations, and organized labor and use networking techniques to develop and maintain professional relationships.

1.1.5. Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, résumé writing, interviewing skills, portfolio development).

1.1.6. Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles.
1.1.8. Identify the correlation between emotions, behavior, and appearance and manage those to establish and maintain professionalism.

1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.
1.1.11. Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them.
1.1.12. Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits, and abusive behavior.

1.2.9. Identify advantages and disadvantages involving digital and/or electronic communications (e.g., common content for large audience, control of tone, speed, cost, lack of non-verbal cues, potential for forwarding information, longevity).

1.2.10. Use interpersonal skills to provide group leadership, promote collaboration, and work in a team.
1.2.11. Write professional correspondence, documents, job applications, and résumés.

1.2.13. Identify stakeholders and solicit their opinions.
1.2.14. Use motivational strategies to accomplish goals.

1.3.1. Analyze how regulatory compliance affects business operations and organizational performance.
1.3.2. Follow protocols and practices necessary to maintain a clean, safe, and healthy work environment.

1.3.4. Identify how federal and state consumer protection laws affect products and services.
1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], U.S. Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

1.3.6. Identify deceptive practices (e.g., bait and switch, identity theft, unlawful door-to-door sales, deceptive service estimates, fraudulent misrepresentations) and their overall impact on organizational performance.
1.3.7. Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g., harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act, Fair Labor Standards Acts, Equal Employment Opportunity Commission).
1.3.8. Verify compliance with computer, copyright, and intellectual property laws and regulations.
1.3.9. Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal, organizational, and professional ethical standards.

1.4.3. Verify compliance with security rules, regulations, and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to industry pathway.
1.4.6. Use electronic database to access and create business and technical information.
1.4.7. Use personal information management and productivity applications to optimize assigned tasks (e.g., lists, calendars, address books).

1.4.8. Use electronic media to communicate and follow network etiquette guidelines.

STUDENT ASSESSMENT POLICY
Project Lead The Way
West Shore Career - Technical District

The student shall perform competencies and competency and key indicators in a manner acceptable to the Standards of the Project Lead The Way advisory committee members and employers in the business community and evaluated by the teacher following these guidelines. Competencies will be identified which must be mastered in order to receive credit for 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:

- Post tests
- Teacher observation and assessment
- Self-assessments
- Class discussions
- Sketch Books
- Project development
- Daily grades
- Quarterly progress reports
- Daily grades
- Lab performance
- Notebook

Measurement of learning will be an on-going activity with emphasis on laboratory activities and core standard improvement. Evaluation will be done through pre-assessment of student skills, frequent formative assessment, both visual and written, and summative assessment to determine mastery of competencies. The number of competencies mastered will be translated into appropriate grades consistent with the school’s grading system and consistent with district and school policy.

Lakewood City School District’s Grading Scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percent Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>96.50 – 100</td>
</tr>
<tr>
<td>A</td>
<td>92.50 – 96.49</td>
</tr>
<tr>
<td>A-</td>
<td>89.50 – 92.49</td>
</tr>
<tr>
<td>B+</td>
<td>86.50 – 84.49</td>
</tr>
<tr>
<td>B</td>
<td>82.50 – 86.49</td>
</tr>
<tr>
<td>B-</td>
<td>79.50 – 82.49</td>
</tr>
<tr>
<td>C+</td>
<td>76.50 – 79.49</td>
</tr>
<tr>
<td>C</td>
<td>72.50 – 76.49</td>
</tr>
<tr>
<td>C-</td>
<td>69.50 – 72.49</td>
</tr>
</tbody>
</table>
The **Project Lead The Way** programs will take a final examination as released by the advisory committee of Project Lead The Way national assessment team, attesting to the students’ abilities.