TN Department of Education | College, Career and Technical Education

Principles of Manufacturing

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	5922
Co-requisite(s):	*Algebra I* (0842, 3102)*, Geometry* (0843, 3108)*, Physical Science* (3202) (recommended)
Credit:	1 credit for core and two focus areas. 2 credits for all 35 standards.
Grade Level:	9
Graduation Requirement:	This course satisfies one or two of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the first course in the *Machining Technology, Electromechanical Technology, Mechatronics,* and *Welding* programs of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	All Advanced Manufacturing POS: Machining Level 1- Measurement, Materials, and Safety Certification (NIMS) –and/or- Snap On Precision Measurement Instruments Certification
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 157, 230, 231, 232, 233, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047), (043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and 046), (044 and 047), (044 and 077), (044 and 078), (044 and 079), (045 and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079), (046 and 047), (046 and 077), (046 and 078), (046 and 079), (047 and 077), (047 and 078), (047 and 079), (077 and 078), (077 and 079), (078 and 079), 470, 477, 501, 502, 522, 523, 531, 537, 551, 552, 553, 554, 555, 556, 557, 575, 582, 584, 585, 596, 598, 700, 701, 705, 706, 707, 760
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Course Description

Principles of Manufacturing is designed to provide students with exposure to various occupations and pathways in the Advanced Manufacturing career cluster, such as Machining Technology, Electromechanical Technology, Mechatronics, and Welding. In order to gain a holistic view of the advanced manufacturing industry, students will complete all core standards, as well as standards in two focus areas. Throughout the course, they will develop an understanding of the general steps involved in the manufacturing process and master the essential skills to be an effective team member in a manufacturing production setting. Course content covers basic quality principles and processes, blueprints and schematics, and systems. Upon completion of this course, proficient students will advance from this course with a nuanced understanding of how manufacturing combines design and engineering, materials science, process technology, and quality. Upon completion of the *Principles of Manufacturing* course, students will be prepared to make an informed decision regarding which Advanced Manufacturing program of study to pursue.

The following implementation options are encouraged:

- 1 credit for Core and two focus areas (listed below)
- 2 credits for all 35 standards.

Core standards are required for both one and two credit implementation options.
Core standards: 1-22, 35

Focus Areas	**Standards**
Machining Technology	23, 24, 25
Mechatronics	26, 27, 28
Electromechanical Technology	29, 30, 31
Welding	32, 33, 34

Program of Study Application

This is the first course in the *Machining Technology, Electromechanical Technology, Mechatronics,* and *Welding* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Advanced Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Occupational Safety and Health Administration (OSHA) guidelines, (4) American Society for Testing Materials, (4) ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply.

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment.

Overview of Manufacturing

3) Define manufacturing and describe how it is used to solve problems. Research the five general steps of manufacturing (preparation, processing, assembly, finishing, and packaging). Select a product and trace its development through each of the five steps. For example, deliver a presentation explaining how a smart phone goes from raw materials to final packaged product.

4) Distinguish between primary and secondary processes involved in the manufacture of industrial goods into finished products. Summarize in a graphic illustration or narrative how different processes make use of specific manufacturing applications, such as the use of welding in assembling processes. Relate the specific operations required to implement the following secondary processes:

    a. Casting and molding (e.g., sand casting)
    b. Forging (e.g., metal forming)
    c. Separating (e.g., machining)
    d. Assembling (e.g., welding)
    e. Direct digital and additive manufacturing (e.g., 3-D printing)
    f. Finishing (e.g., electroplating)
    g. Stamping (e.g., stamping press)
    h. Injection Molds (e.g., injecting material into a mold)

5) Research the history of manufacturing. Summarize its evolution from the Industrial Age to the rise of mechanization and automation in the manufacturing industry. Create a timeline or infographic that identifies milestones in the industry that led to today's advanced manufacturing environments. For example, discuss both the history of the assembly line and the use of robots, describing how they transformed the manufacturing industry.

6) Explain that manufacturing is a technological system that transforms raw materials into products in a central location (e.g., a factory). Technological systems include the following elements: inputs, processes, outputs, feedback, and goals. As a team, select a manufacturing system, such as metal fabrication, and use diagrams and other multimedia to demonstrate its operation. Identify each element and explain its role in the system.

7) Explore the onset of advanced manufacturing and explain how it applies information, automation, computation, software, sensing, and networking to make traditional processes more efficient. Describe how advanced manufacturing incorporates the use of modern materials and recent discoveries in physical and biological sciences. For example, report on the use of nanotechnology.

Materials

8) Identify and describe a wide range of materials used in manufacturing: organic, inorganic, engineering (metallic, polymeric, ceramic, composite), and non-engineering (gases and liquids). Distinguish between the materials and provide examples of how they are converted into products.

9) In teams, research the major material properties: physical, mechanical, chemical, thermal, electrical/magnetic, acoustical, and optical. Considering the use of materials in the various areas of advanced manufacturing (e.g., welding, machining, mechatronics, and electromechanical technology), discuss the following:
    a. Characteristics that make up the physical properties of a material
    b. How the mechanical properties affect the way a material will react to forces or loads
    c. How natural elements react with a material and affect its performance
    d. Characteristics that make up thermal properties of a material (e.g., thermal resistance, thermal expansion, thermal emission, thermal shock resistance)
    e. Three major groups of materials that carry an electrical current (e.g., conductors, semiconductors, resistors)
    f. Two major properties that describe how a material reacts to sound waves (e.g., acoustical transmission, acoustical reflection)
    g. Three general optical properties (e.g., color, light transmission, light reflection).

    Explain why these properties are important to the selection and application of materials in a production setting.

Career Exploration

10) In teams, use an online editing tool to develop an informational paper or infographic illustrating various career opportunities and pathways in the advanced manufacturing industry (welding, mechatronics, machining technology, and electromechanical technology). The descriptions should contain definitions, job roles, professional societies, and applicable licenses and/or certifications associated with each career. Use a variety of sources to gather data, cite each source, and briefly describe why the chosen source is reliable.

11) Research the postsecondary institutions (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer programs leading to careers in advanced manufacturing. Write an informative paper or develop an infographic identifying admissions criteria, the postsecondary programs of study, and the secondary courses that will prepare individuals to be successful in a postsecondary program.

Layout and Measurement

12) Identify and demonstrate proper use of the following typical measuring tools. Determine when it is appropriate to use linear distance, diameter, and angle measuring tools, and record accurate and repeatable measurements, attending to appropriate units and quantities.
    a. Tape rule
    b. Machinist's rule

c. Bench rule
d. Caliper
e. Divider
f. Depth gage
g. Micrometer
h. Square
i. Protractor
j. Combination set

13) Explain why proper layout is critical to making parts properly. Select a typical part and correctly demonstrate the following steps, or use a similar multistep procedure, to lay out the shape of a part.
    a. Measure off the part size on standard stock.
    b. Cut the part blank out of the standard stock.
    c. Draw center lines for holes and arcs.
    d. Locate holes and arcs.
    e. Mark centers of holes.
    f. Draw tangent lines.
    g. Layout straight cuts.

Blueprint Reading and Interpretation

14) Define the differences in technique among freehand sketching, manual drafting, and computer-aided drafting (CAD), and describe the skills required for each. Create a two-dimensional orthographic (multiview) drawing incorporating labels, notes, and dimensions, using sketching/geometric construction techniques. Apply basic dimensioning rules and properly use different types of lines (e.g., object, hidden, center). The orthographic projections should include principle views of a simple object from top, front, and right sides.

15) Compare and contrast the following types of engineering drawings. Describe the characteristics and explain the different applications of each drawing type. Identify and distinguish between symbols that are unique to the different pathways in advanced manufacturing (e.g., machining technology, electromechanical technology, mechatronics, and welding). For example, electromechanical technology often uses schematic symbols for common electrical components and machining technology often uses symbols for surface finishes.
    a. Detail drawings
    b. Assembly drawings
    c. Systems drawings

16) Inspect and interpret blueprints, schematic diagrams, or written specifications for manufacturing devices and systems. Explain how the pictorial representations relate to an actual project layout, verifying sufficient agreement as prescribed by specified tolerances. For example, use a hydraulic schematic to show how fluid travels through a hydraulic circuit in an actual system.

Sequencing of Manufacturing Operations

17) In teams, investigate the role of a manufacturing engineer in designing efficient manufacturing systems. Create samples of the following documents which engineers often use to ensure that manufacturing operations are completed in a logical and efficient order. Use the sample documents to manage the completion of short projects and assignments in this course. Documents include the following:
    a. Operation sheet
    b. Flow process chart
    c. Operations process chart

Quality Assurance and Continuous Improvement

18) In teams, research the three basic types of data that are important to controlling the manufacturing of a product: product output data, quality control data, and labor data. Describe and explain each type, including sample illustrations of the various reports needed by analysts (e.g., production report, material rejection form, inspection report). Provide examples of how a process can be improved depending on the outcome of each data type.

19) Examine common statistical processes to analyze data. As a class, develop standard procedures for analysis to apply to manufacturing projects throughout the course and program of study. The procedures should include:
    a) Collection of data
    b) Analysis methods
    c) Interpretation of results

20) Define the concept of quality control in the manufacturing industry. Summarize the roles of various personnel involved in ensuring quality control over production, including those who make the products, those who design the processes, and those who inspect the finished products. Describe why quality control is important to manufacturing processes, including how it affects customers, retailers, and manufacturers. Provide examples of how quality control could be applied to various manufacturing practices like electromechanical technology, machining technology, mechatronics, and welding.

21) As a class, research quality improvement tools and strategies such as the Plan-Do-Check-Act cycle, and collaboratively create quality control guidelines and reports to reference as products are fabricated and assembled throughout the semester and program of study. Include plans for corrective action to address common quality problems.

22) Investigate the functions of process management in a manufacturing workplace: planning, organizing, directing, and controlling. Explain each function and describe the relationship between process management and quality assurance. For example, compare and contrast the costs of preventive maintenance, safety practices, and quality control with the costs of equipment repair, workplace accidents, and inefficient processes.

Machining Technology

23) Demonstrate proper application of common machine shop hand tools. Identify the following tools and provide examples of how they should be used safely.
    a. Clamping devices
    b. Pliers
    c. Wrenches
    d. Screwdrivers
    e. Chisels
    f. Hacksaws
    g. Reamers
    h. Hand taps
    i. Dies

    Given a specific machining assignment, select two or more of the above hand tools for the task. Explain why the tools were selected to complete the assignment.

24) Identify and explain the equipment, equipment setup, and techniques that apply to the following operations:
    a. Sawing
    b. Drilling
    c. Grinding
    d. Milling

    Given a specific machining assignment, comply with safe and efficient work practices and perform basic operations using both manual and machine-guided techniques. Properly set controls and speeds of the machines; remove and replace parts; and visually examine machined surfaces for meeting the given specifications.

25) Research the development of numerical control machines, including how computer numerical control (CNC) technology evolved. Compare and contrast CNC machines with manually controlled machines and identify the chief benefits associated with them. Demonstrate operation of a CNC machine to perform basic tasks.

Mechatronics

26) In teams, research the history of mechatronics and summarize how it evolved into modern-day applications. Using the research findings, create an infographic or presentation that can be used to (a) explain the mechatronics field, (b) why it is critical to the advanced manufacturing industry, (c) the skills needed to be successful in this field, and (d) why there is a demand for mechatronics professionals.

27) Identify and describe the following components of a typical mechatronic system. Select a common machine, such as a robot or a copy machine, to illustrate an example of a mechatronic system. Using supporting evidence from the machine and/or its accompanying schematic, explain why the machine is considered a mechatronic system.
    a. Actuators
    b. Sensors
    c. Digital control devices

d. Input devices
e. Output devices
f. Graphical displays

28) Log, store, and export data received from two or more sensors (e.g., vision/light, audio, and touch) in a robotic or automated system. Explain why these procedures would be useful in a manufacturing process and provide specific examples.

Electromechanical Technology

29) Explain how belt drives and chain drives are used to transmit power in an electromechanical system. Compare and contrast the two drive types and describe the advantages and disadvantages of using each. Make a claim about the appropriate drive type for a given situation, citing data and evidence to support claim and address counterclaims.

30) Identify and define the following common electrical quantities, including the unit of measurement and symbol (abbreviation) for each unit.
    a. Current
    b. Voltage
    c. Resistance
    d. Conductance
    e. Power
    f. Charge

31) Compare and contrast the two types of fluid power systems (pneumatic and hydraulic). Describe and explain the components they have in common; then identify the characteristics that render certain advantages to using one system over the other. For example, heavy construction machinery often uses hydraulic systems because they have the ability to support heavy loads.

Welding

32) Interpret welding-specific drawings and welding symbol information. Differentiating between drawings and blueprints, examine parts to determine the application of symbols from drawings, sketches, and blueprints.

33) Examine given shop and assembly drawings for a weldment composed of five to ten components. Interpret the dimensions and write a plan describing the materials and tools needed to complete the assignment. Make the required cuts and execute the plan.

34) Identify and explain the equipment, equipment setup, and techniques that apply to the following thermal cutting operations:
    a. Oxyfuel cutting
    b. Plasma-arc cutting
    c. Air carbon arc cutting
    d. Sawing
    e. Shearing

f. Punching

Perform straight, shaped, and beveled cutting operations using both manual and machine-guided techniques. Properly use weld-washing techniques and visually examine cut surfaces for meeting the given specifications.

Latest Trends in Advanced Manufacturing

35) Explore a range of new and emerging trends in advanced manufacturing. A trend could be the change in the types of skills needed in manufacturing, the use of computers, or the use of advanced materials in recent years. Examples include the following:
    a. Sensing, measurement, and process control
    b. Materials design, synthesis, and processing
    c. Digital manufacturing technologies
    d. Sustainable manufacturing
    e. Nanomanufacturing
    f. Flexible electronics manufacturing
    g. Biomanufacturing
    h. Additive manufacturing
    i. Industrial robotics
    j. Advanced forming and joining technologies

    Research one or more of these trends in depth, and compile, review, and revise a presentation or a paper explaining both the technical aspects involved (i.e., what skills are needed) and the effects on businesses, workers, and society.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

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Welding I

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6078
Pre-requisite(s):	*Principles of Manufacturing* (5922) Recommended: *Algebra* (0842, 3102), *Geometry* (0843, 3108), and *Physical Science* (3202)
Credit:	1
Grade Level:	10
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the second course in the *Welding* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	AWS SENSE- Entry Level Welder
Dual Credit or Dual Enrollment Opportunities:	There are available known dual credit/dual enrollment opportunities for this course. If interested, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	551, 552, 553, 554, 555, 556, 557, 584, 705, OR any other Occupational License endorsement with AWS Industry Certification, BAT, or Certified Welding Educator Certification
Required Teacher Certifications/Training:	In addition, the teacher must hold one of the following current/valid industry certifications: American Welding Society (AWS), Certified Welding Inspector (CWI), Certified Welding Educator (CWE), Certified Radiographic Interpreters, Certified Welding Engineer (CWEng), Certified Robotic Arc Welder (CRAW), Certified Welding Fabricator, Certified Welder OR Bureau of Apprenticeship Training certification (BAT), or NOCTI Welding.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Course Description

Welding I is designed to provide students with the skills and knowledge to effectively perform cutting and welding applications used in the advanced manufacturing industry. Proficient students will develop proficiency in fundamental safety practices in welding, interpreting drawings, creating computer aided drawings, identifying and using joint designs, efficiently laying out parts for fabrication, basic shielded metal arc welding (SMAW), mechanical and thermal properties of metals, and quality control. Upon completion of this course, proficient students will be able to sit for the AWS SENSE Entry Level Welder certification and will be prepared to undertake more advanced welding coursework.

Program of Study Application

This is the second course in the *Welding* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Advanced Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

36) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Occupational Safety and Health Administration (OSHA) guidelines, (4) American Society for Testing Materials; ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. Complete safety test with 100 percent accuracy.

37) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment.

Career Exploration

38) Locate and assess the American Welding Society website and analyze its structure, policies, and requirements for the AWS Entry Welder qualification and certification. Explain a welder certification document, what steps are required to obtain the certification, and how to prepare for the examination.

Interpreting and Creating Drawings

39) Compare and contrast the architectural scale versus the engineering scale used in mechanical drawings. Describe their distinguishing characteristics. Define a scale and perform conversion calculations of various distances.

40) Building on the knowledge of a two-dimensional drawing, create simple isometric (3-D pictorial) drawings, properly using lines (e.g., object, hidden, center), labels, and dimensioning techniques.

Welding Design and Layout

41) Identify, sketch, and explain the five basic weld joint designs (e.g., butt, lap, tee, outside corner, and edge). Find examples of various joint designs applied to structures on or around campus and take pictures to present to classmates.

Shielded Metal Arc Welding (SMAW)

42) Safely set up equipment for shielded metal arc welding (SMAW). Identify and explain the equipment, equipment setup, and the electrical current used in the welding process. Drawing on multiple resources, compare and contrast SMAW with other welding and cutting processes such as oxyfuel gas welding (OFW), gas metal arc welding (GMAW), flux-cored arc welding (FCAW), and gas tungsten arc welding (GTAW). Write a brief informative paper discussing the distinguishing characteristics and primary advantages of each.

43) Demonstrate how to make single- and multiple-pass fillet welds and groove welds with backing on plain carbon steel in the following positions. Prior to welding, sketch a cross section, including the dimensions of each weld demonstration.
    a. Flat
    b. Horizontal
    c. Vertical
    d. Overhead

44) Research the American Welding Society (AWS) filler metal classification system and write a paper explaining the system, briefly discussing the multiple factors that affect electrode selection for shielded metal arc welding (SMAW). Using various electrodes, demonstrate how to make pad beads on plain carbon steel in the following positions.
    a. Flat
    b. Horizontal
    c. Vertical
    d. Overhead

    Summarize the demonstration results of using various electrodes and explain the findings using supporting evidence from the AWS metal classification system.

Properties of Metals

45) Research the following mechanical properties of metals and their importance in the welding process.
    a. Tensile
    b. Strength
    c. Hardness
    d. Elasticity
    e. Ductility
    f. Toughness
    g. Brittleness

Create a chart or table that compares and contrasts the meaning of these properties. Explain the changes in the mechanical properties of weldments that occur during the welding process.

46) Investigate the thermal properties of metals and their effects on welding processes. Describe and demonstrate techniques to mitigate the effects of thermal expansion and contraction that occur during the welding process. During the demonstrations, observe and record the changes that occur in the mechanical properties of weld and parent metals caused by heating and cooling. Write a report summarizing and explaining the findings. Justify all explanations with supporting evidence gathered from observations and welding principles.

47) Design an experiment to test and compare the effect that thermal conductivity and specific heat have on various metals such as steel and aluminum. Record all observations and write a report to present the test results in an electronic format, integrating quantitative and visual information. The report should include, but should not be limited to, explaining the effect of thermal conductivity on the heating and cooling rates observed during the welding process, as well as the effect of specific heat on heat rates required for welding.

Quality Control

48) Drawing upon multiple resources, research and write a text explaining the relationship between discontinuities and defects. Describe various examples of defects found in welded products. Also identify and explain both destructive and nondestructive tests used as quality control techniques to prevent manufacturing defects in welding. Compare and contrast these techniques and provide specific examples when they are most appropriately used. Cite evidence to justify the examples.

49) Measure and visually inspect welded products for acceptability to American Welding Society QC-10 standards. Record discontinuities and defects, and compare data to given project specifications using class-defined analysis methods. Interpret and communicate results both written and verbally. If necessary, recommend changes that will reduce the number of product defects during the manufacturing process.

Welding Procedure Specification Development

50) Research the American Welding Society (AWS) Specification for Welding Procedure and Performance Qualification (AWS B2.1/B2.1M) to learn more about Welding Procedure Specifications and the use of the document. Explain the significance of this document and define the following elements:
    a. Joint Design
    b. Base Metal
    c. Filler Metal
    d. Position
    e. Preheat and Interpass
    f. Heat Treatment
    g. Shielding Gas
    h. Electrical

51) Investigate procedure qualification variables associated with the above elements and their effects on welding processes. Describe techniques to mitigate the effects of these variables

that can occur during the welding process. Write a report summarizing and explaining the findings. Justify all explanations with supporting evidence gathered from observations and welding principles.

52) Read and interpret an example of a welding procedure specification and observe demonstrations of qualified welders to understand the proper procedures involved in conducting a welding procedure test. Create a training document to instruct a new welders on how to properly use the welding procedure specification to help successfully conduct a welding procedure test. Include the following:
    a. Code Requirements
    b. Materials
    c. Documentation
    d. Destructive Testing
    e. Inspection and evaluation

53) Apply knowledge previously learned to properly demonstrate the ability to review a welding procedure specification and conduct a welding procedure test. Steps must include:
    a. Properly setting up welding equipment for the process being tested
    b. Properly select base material and filler metal (gas shielding if required)
    c. Gathering equipment needed to capture welding variables
    d. Properly set up test coupon (per code, or as performed in production)
    e. Properly document data as coupon is being welded
    f. Performing visual inspection
    g. Performing destructive testing
    h. Completing the Welding Procedure Specification document

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

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Welding II

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6033
Pre-requisite(s):	*Welding I* (6078) Recommended: *Algebra* (0842, 3102), *Geometry* (0843, 3108), *Physical Science* (3202)
Credit:	2
Grade Level:	11-12
Graduation Requirement:	This course satisfies two of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the third course in the *Welding* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	AWS SENSE Advanced Level Welder American Welding Society Certified Welder
Dual Credit or Dual Enrollment Opportunities:	There are available dual credit/dual enrollment opportunities for this course. If interested, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	551, 552, 553, 554, 555, 556, 557, 584, 705, OR any other Occupational License endorsement with AWS Industry Certification, BAT, or Certified Welding Educator Certification.
Required Teacher Certifications/Training:	In addition, the teacher must hold one of the following current/valid industry certifications: American Welding Society (AWS), Certified Welding Inspector (CWI), Certified Welding Educator (CWE), Certified radiographic Interpreters, Certified Welding Engineer (CWEng), Certified Robotic Arc Welder (CRAW), Certified Welding Fabricator, Certified Welder OR Bureau of Apprenticeship Training certification (BAT), or NOCTI Welding.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Course Description

Welding II is designed to provide students with opportunities to effectively perform cutting and welding applications of increasingly complexity used in the advanced manufacturing industry. Proficient students will build on the knowledge and skills of the *Welding I* course and apply them in novel environments, while learning additional welding techniques not covered in previous courses. Specifically, students will be proficient in (1) fundamental safety practices in welding, (2) gas metal arc welding (GMAW), (3) flux cored arc welding (FCAW), (4) gas tungsten arc welding (GTAW), and (5) quality control methods. Upon completion of the *Welding II* course, proficient students will be eligible to complete the American Welding Society (AWS) Entry Welder or the AWS SENSE Advanced Welders qualifications and certifications.

Program of Study Application

This is the third course in the *Welding* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Advanced Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

54) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Occupational Safety and Health Administration (OSHA) guidelines, (4) American Society for Testing Materials; ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. Complete safety test with 100 percent accuracy.

55) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment.

Gas Metal Welding (GMAW)

56) Safely set up equipment for gas metal arc welding (GMAW). Identify and explain the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, research the advantages of using GMAW over conventional electrode-type arc (stick) welding. Write a brief informative paper distinguishing the characteristics. For example, explain why it is easier to control the small molten weld pool using the GMAW process.

57) Research the American Welding Society (AWS) filler metal classification system, and write a brief paper explaining the system, discussing the multiple factors that affect electrode selection for gas metal arc welding (GMAW). For example, the 80 in ER80S-D2 designates the minimum tensile strength of the deposited weld metal in thousands.

58) Using the gas metal arc welding (GMAW) process and various metal transfer methods (e.g., short-circuit, pulse-arc, globular, and spray transfer), demonstrate how to pad beads and make fillet welds on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead). Summarize the demonstration results, distinguishing between the metal transfer methods used, and explain the equipment adjustments made to change between metal transfer methods as if narrating a technical process to an audience.

Flux Cored Arc Welding (FCAW)

59) Safely set up equipment for flux cored arc welding (FCAW). Identify and explain the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, research the advantages and limitations of FCAW. Write a brief informative paper distinguishing these characteristics. For example, determine which types of metals and alloys are most applicable for the use of FCAW.

60) Refer to previous research conducted on the filler metal classification system by the American Welding Society (AWS). Using proper domain-specific terminology, explain in a presentation to a technical audience the multiple factors that affect electrode and shielded gas selection for flux cored arc welding (FCAW). For example, manufacturers sometimes consider the exact composition of fluxes a trade secret and do not provide enough details to classify electrodes. As a result, AWS uses G for electrodes that have not been classified.

61) Using various electrodes and the flux cored arc welding (FCAW) process, demonstrate how to pad beads and make fillet welds on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead). Over time, routinely document observations such as the effects of metal surface conditions, voltage drop, welding position, and wire feed speed. Summarize the demonstration results of using various electrodes and explain the findings using supporting evidence from the AWS metal classification system and other resources.

62) Identify and explain the following distinctive features about flux cored arc welding (FCAW): arc-control, oxidation-prevention, self-shielded FCAW, and gas-shielded FCAW. Describe and demonstrate specific examples of how metal transfer is affected by arc-control, self-shielded, and gas-shielded FCAW. Explain the importance of using recommended gas mixtures.

Gas Tungsten Arc Welding (GTAW)

63) Safely set up equipment for gas tungsten arc welding (GTAW). Identify and explain the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, compare and contrast water-cooled welding torches versus air-cooled welding torches used in GTAW. Write a brief paper distinguishing the characteristics and the appropriate applications of each torch type. For example, determine which torch is preferred in production welding contexts and explain why.

64) Refer to previous research conducted on the filler metal classification system by the American Welding Society (AWS). Discuss the multiple factors that affect electrode selection for gas tungsten arc welding (GTAW). For example, pure tungsten (EWP) is not typically used

with alternating current (AC) welding of materials because it has poor heat resistance and electron emission.

65) Using various electrodes and the gas tungsten arc welding (GTAW) process, demonstrate how to pad beads and make fillet welds on plain carbon steel, stainless steel, and aluminum in all feasible positions (e.g., horizontal, flat, vertical, overhead). Summarize the demonstration results of using various electrodes and explain the findings using supporting evidence from the AWS metal classification system and other resources.

66) Identify and explain the following distinctive features about gas tungsten arc welding (GTAW): arc-control, oxidation-prevention, and gas-shielded GTAW. Describe and demonstrate specific examples of how metal transfer is affected by various shielded gas GTAW (e.g., argon, helium, hydrogen, nitrogen). Identify which gases are noble inert gases and explain why this is a distinguishing characteristic.

Quality Control

67) Measure and visually inspect welded products for acceptability to American Welding Society QC-10 standards. Record discontinuities and defects and compare data to given project specifications using class-defined analysis methods. Interpret and communicate results both written and verbally. If necessary, recommend changes that will reduce the number of product defects during the manufacturing process.

68) Drawing upon multiple resources, research nondestructive testing beyond visual inspection, such as penetrant inspection, magnetic particle inspection, radiographic inspection, and ultrasonic inspection. Describe how these tests are applied as quality control techniques to prevent manufacturing defects in welding. Compare and contrast these techniques and provide specific examples for when they are most appropriately used. Cite evidence to justify the examples. Demonstrate the proper use of the magnetic particle and penetrant inspection tests on weldment samples of gas metal arc welding (GMAW), flux cored arc welding (FCAW), and gas tungsten arc welding (GTAW) processes.

69) Describe and distinguish between the guided-bend test and the free-bend test. Explain when it is most appropriate to apply each test. Demonstrate the use of each test and properly document results on a mock qualification test record form conforming to the American Welding Society (AWS) requirements. For example, perform root- and face-guided bend tests on a butt joint weld coupon.

Welding Efficiency

70) Analyze and differentiate among various types of elements that can directly impact welding efficiency. Create a table or other graphic organizer that lists the following types of elements and details how their purposes and characteristics can directly affect efficiency:
    a. Arc time
    b. Operating Factor
    c. Deposition Rate (wire feed speed)
    d. Electrode Efficiency

e. Travel Speed
f. Weld Size
g. Poor Fit
h. Defects/Repairs

71) Research and explore how wire feed speed and weld size influences efficiency. Demonstrate the consequences of using different variables in relation to wire feed speed and weld size. Upon completion of the work, write an explanation and justify observations identifying different methods used and their final impact on efficiency.

72) Research and evaluate the differences between Fillet and Groove Welds. Drawing on evidence from textbooks and other resources, create a table or other graphic organizer that details their purposes and characteristics, the costs associated with each weld, and a calculation of how long it would take a welder to successfully create each type.

Industry Certification and Portfolio

73) Pursue the industry certification exam (e.g., American Welding Society SMAW module) using the shielded metal arc welding (SMAW) process. Demonstrate how to make multiple-pass open-butt groove welds on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead) conforming to American Welding Society quality standards.

74) In preparation for industry certification exams (e.g., American Welding Society GMAW, FCAW, and GTAW modules), complete assigned team projects that incorporate the following welding processes in order to design, fabricate, evaluate, and test products made in this course. For each project, produce a technical report documenting illustrations, findings, and justifications for project solutions. Compile photographs of each project, along with technical documentation, into a portfolio of work.
    a. Using the gas metal arc welding (GMAW) process and various metal transfer methods (e.g., short-circuit, pulse-arc, and spray transfer), demonstrate how to make a complete joint penetration weld on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead) conforming to American Welding Society quality standards.
    b. Using the flux cored arc welding (FCAW) process, demonstrate how to make a complete joint penetration weld on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead) conforming to American Welding Society quality standards.
    c. Using electrodes and the gas tungsten arc welding (GTAW) process, demonstrate how to complete joint penetration welds on plain carbon steel, stainless steel, and aluminum in all feasible positions (e.g., horizontal, flat, vertical, overhead) conforming to American Welding Society quality standards.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

TN Department of Education | College, Career and Technical Education

Business Management

Primary Career Cluster:	Business Management & Administration
Consultant:	Tara Campbell, (615) 253-7442, Tara.Campbell@tn.gov
Course Code(s):	5889
Prerequisite(s):	*Introduction to Business & Marketing* (5905)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Business courses.
Programs of Study and Sequence:	This is the third course in the *Business Management* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Industry Certifications	None
Dual Credit or Dual Enrollment	There are currently dual credit opportunities available for this course at specific community colleges. Reach out to a local postsecondary institution(s) for more information.
Teacher Endorsements	030, 035, 039, 052, 054, 056, 057, 152, 153, 158, 201, 202, 204, 311, 430, 433, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

Business Management focuses on the development of the planning, organizing, leading, and controlling functions required for the production and delivery of goods and services. This applied knowledge course addresses the management role of utilizing the businesses' resources of employees, equipment, and capital to achieve an organization's goals. Students will participate in a continuing project throughout the course in which, individually or in teams, they will present recommendations to improve an existing business. Local business partnerships are encouraged to provide resources for faculty and students. Upon completion of this course, proficient students will be able to complete a full review of an existing business and offer recommendations for improvement as would a management consultant.

Program of Study Application

This is a capstone course in the *Business Management* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Business Management & Administration website at https://tn.gov/education/article/cte-cluster-business-management-administration.

Course Standards

Role of Management

1) Describe the management process and examine the functions of management (planning, organizing, leading, and controlling). Through review of case studies or news media, illustrate how concerns for the environment, an increasingly diverse workforce, globalization of the marketplace, and rapidly changing technology have impacted how businesses apply these functions.

2) Analyzing the two components of industrial psychology—workplace productivity and employee well-being,—explore the characteristics of and distinguish between various management theories (such as scientific management, Total Quality Management (TQM), Ouchi's Theory Z, Six Sigma, Situational Leadership, etc.). Drawing on information from research, illustrate how economic, political, or cultural decisions influence management theories that have been applied in the business environment. For example, hypothesize how Maslow's Hierarchy of Needs affects theories of management.

3) Distinguish between historical management theories (such as Scientific Management Theory, Human Relations Movement, etc.) and modern management theories (such as Contingency Theory, Systems Theory, Chaos Theory, etc.) then compare and contrast similarities and differences. Discuss ways in which major historical events and dramatic shifts in societal processes and procedures have informed the evolution of management theories. Identify factors and variables that have influenced changes, progressions, and/or modifications to theories of management.

4) Research the management skills needed in today's business environment (such as goal setting, decision making, communications, delegation, technical skills, motivational and leadership skills). Through the analysis of case studies, discuss the role of business leaders who have been recognized for their influence on modern managerial approaches (such as Theory Z's William Ouchi, General Electric's Jack Welch, Hewlett-Packard's Carleton Fiorina,

or Facebook's Sheryl Sandberg). Synthesize research to produce a profile of a strong candidate for a business manager, citing specific evidence from text.

5) Select a historical and a modern theory of management and develop a business plan for a proposed organization using each identified approach. Include a clear comparison of the two business plans with differences clearly defining and explaining the variables contributing to these variations. Create a graphic that illustrates each component of a business plan (such as executive summary, business description, products and services, etc.) which clearly distinguishes the differences between the plan using a historical theory and the plan using a modern theory.

Planning and Strategic Management

6) Analyze the elements of sample business plans or business plan templates found in informational text, identifying and describing the purpose of common elements. Discriminate between elements that govern culture (such as vision, mission, core priorities and social responsibility) and those that may govern operational goals (such as market share, profitability, and product development).

7) Investigate and choose an existing business to research (individually or in teams) throughout the duration of the course. Describe the business' current target market, primary products or services offered, unique characteristics, current market position, and customer volume by summarizing available public documents about the business.

8) Design, write, modify and evaluate a business plan for the identified existing business. The business plan should include, but may not be limited to, detailed descriptions of products and/or services offered, risk analysis, short and long term profits, marketing plan, investment needed to start and maintain the business, plans to obtain working capital, legal licenses, and vendor contracts. Include a company organization chart, job description and skills needed of main employees, physical equipment and facilities required, and any future expansion plans.

9) Study benchmark indicators included in a SWOT (Strength, Weaknesses, Opportunities, and Threats) analysis and conduct a SWOT analysis of the selected business using data and evidence collected from personal interviews, observations, print articles, and internet searches. Citing specific data and evidence, make a claim about the business' most significant weakness(es), or area(s) of opportunity, to address throughout the duration of the course.

Business Process Considerations

10) Create a new, or recommend updates to an existing, mission statement for the selected business by summarizing information gleaned from personal interviews, observations, print articles, and internet searches about the specific aspirations, beliefs, and values of the company.

11) Conduct a PEST analysis (Political issues, Economic factors, Socio-cultural factors, Technology) of the selected business, including available geographic, demographic and economic data gathered from multiple authoritative sources. Based on the analysis, make a prediction about necessary factors which need to be considered in order to accurately

address the businesses' most significant weakness(es) or area(s) of opportunity selected in standards 6.

Marketing Considerations

12) Identify up to five businesses that could be considered competitors of the selected business. Gather and summarize information about the competition succinctly in a chart, table, or graphic. Information may include variety of products available, location, prices, services, and other unique characteristics.

13) Make a claim about the current target market of the selected business, developing and supporting the claim and counterclaim(s) with data and evidence provided by the business and from research on potential competitors. Develop a detailed customer profile to summarize characteristics, including the BPI (Buying Power Index), for the target market.

14) Using previous research on the selected business and its competitors, describe typical prices in the industry for similar products or services, noting how the prices of the selected business compare to others. Summarize how businesses make and review pricing decisions based on four key market factors: cost and expenses, supply and demand, consumer perception, and competition. Analyze each factor for the selected business and summarize how each relates to typical organizational goals of earning a profit, gaining market share, and being competitive, noting where there are chances to address weakness(es) or capitalize on area(s) of opportunity identified in standard 6.

Organizational Considerations

15) Describe advantages and disadvantages of the basic forms of business ownership (sole proprietorship, partnership, and corporation) and identify variations of basic forms of business ownership (franchise, limited partnership, cooperative, limited liability company, and S corporation). Determine which ownership structure is employed by the selected business and hypothesize why it was selected. Review copies of available partnership agreements, articles of incorporation or franchise contracts, noting characteristics important for successful operation of a given business.

16) Document existing operations plan of the selected business, describing location, hours of operation, customer accessibility, equipment, storage, and inventory needs, and current supply chain elements. Reviewing the most significant weakness(es), or largest area(s) of opportunity for the selected business determined in standards 6, make recommendations about changes to current plan to improve business operations. For example, recommending a new location to improve customer foot traffic.

17) Diagram and describe the organizational structure of the business by creating an organizational chart of existing positions and/or department in the business, paying close attention to documentation of job descriptions (including reporting structures), accurate number of employees, and any outsourced labor.

18) Identify applicable risks to the selected business (such as fire or flood damage or significant theft of inventory) and research available options for risk management, such as insurance. Make a claim about appropriate risk management strategies to employ to

address the businesses' weakness(es) or area(s) of opportunity identified in standard 6, justifying claim with data and evidence from research.

19) Identify and list appropriate national, state, and local bodies governing the operations of the selected business. Review documentation to summarize federal, state, and local regulations and laws (such as environmental regulations, zoning or licensing requirements, and legal stipulations) that are necessary for the continued operations of the selected business.

20) Analyze the essential parts of a contract by reviewing sample contracts and researching the Uniform Commercial Code for basic commercial law. Request a copy of a contract in use at the selected business and review it to recommend potential areas for refinement or improvement.

Human Relations Considerations

21) Create a new, or recommend updates to an existing, employee manual for the selected business by summarizing information gleaned from personal interviews, observations, print articles, and internet searches about the human resource policies and employee expectations of the company. Include the following:
    a. procedures for employee hiring and release
    b. orientation of new employees
    c. performance assessments
    d. handling grievances
    e. compensation packages

22) Describe legal strategies used by labor and management (strikes, boycotts, layoffs, and lockouts) and illegal strategies used by labor and management (wildcat strikes, secondary boycotts, and preventing workers from forming unions). Conduct current event research highlighting recent activities involving labor and management disputes, drawing conclusions about the potential impacts of a labor and management strategy on the selected business, if any.

Financial Considerations

23) Interpret the data shown on financial statements (income statement, balance sheet, cash flow statement, and statement of net worth) of the selected business. Benchmark the business' financial position against others in the industry, by reviewing available public filing documents such as financial statements, annual reports, and statements to shareholders of national firms.

24) Evaluate various financial control tools such as budgets, audits, and financial ratios. Construct a TQM operations cost controlling matrix that includes costs, inventory tracking levels, and turnover rates of the selected business. Identify potential areas of improvement, especially as they relate to the identified weakness(es) and area(s) of opportunities outlined in standard 6.

25) Assess the short-term and long-term financial needs of the selected business, attending to details about the current ownership structure. Evaluate advantages and disadvantages of additional funding through equity capital versus debt capital, noting where potential influx of funding may impact current ownership structure.

26) Analyze the importance of international trade as it relates to small businesses and corporations. Research reasons a company might choose to enter a foreign market, examine cross-cultural communication marketing challenges, the laws and import regulations that govern international trade, and prepare a presentation on how the business could succeed in an international environment.

Final Project

27) As would a management consultant, compile a set of recommendations for the selected business based on the research completed in standards 7-24 to address one or more of the following: streamlining operations, increasing profitability and competitiveness, meeting long-term funding needs, or addressing employee concerns in order to ultimately attend to the weakness(es) and/or area(s) of opportunity identified in standard 6. Plan, revise, edit, and rewrite recommendations throughout the course to ensure focus on what is most significant for a given audience. Present recommendations through both a formal, written report and an oral presentation, including appropriate financial calculations, charts and graphs, and citations for relevant sources.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Business Communications

Primary Career Cluster:	Business Management & Administration
Consultant:	Tara Campbell, (615) 253-7442, Tara.Campbell@tn.gov
Course Code(s):	5888
Prerequisite(s):	*Introduction to Business & Marketing* (5905)
Credit:	1
Grade Level:	10 - 11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Business courses.
Programs of Study and Sequence:	This is the second course in the *Business Management* and *Office Management* programs of study.
Aligned Student Organization(s):	DECA: http://ww.decatn.org FBLA: http://ww.fbla.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	030, 031, 032, 034, 037, 039, 041, 052, 054, 055, 056, 057, 152, 153, 158,201, 202, 203, 204, 311, 430, 432, 433, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

Business Communications is a course designed to develop students' effective oral and electronic business communications skills. This course develops skills in multiple methods of communications, including social media, as well as electronic publishing, design, layout, composition, and video conferencing. Upon completion of this course, proficient students will be able to demonstrate

successful styles and methods for professional business communications using the proper tools to deliver effective publications and presentations.

Program of Study Application

This is the second course in the *Business Management* and *Office Management* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Business Management and Administration website at https://tn.gov/education/article/cte-cluster-business-management-administration.

Course Standards

Communication Components

1) Demonstrate compliance with the school's ethics policy regarding copyrighted materials, plagiarism, authenticity, proper citations, privacy, and proper use of technology resources.

2) Identify, analyze, and critique the basic components of communications, such as the message, the sender, the receiver, the mode, the noise, and the response. This includes conducting responsible research when necessary, developing effective arguments, composing meaningful and coherent messages appropriate to the intended audience, and polishing one's delivery skills to deliver an effective and credible message, followed by listening.

3) Differentiate between verbal and nonverbal communications when interacting with peers, subordinates, superiors, and customers. List specific techniques for effective communications and evaluate how different cultures and generations attach different meanings to various gestures, intonations, and other communications techniques.

4) Practice and implement proven communication techniques to foster positive interpersonal relationships in the business atmosphere, such as:
    a. Establishing and maintaining positive relationships with coworkers and customers (e.g., being fair, helpful, tactful, gracious, and appreciative).
    b. Recognize manifestations of tension, and employ recommended strategies to resolve the situation in the most favorable ways (e.g., collaborating, compromising, accommodating).
    c. Practice various interactions and conflict resolution strategies by participating in role-play exercises and structured controversies, allowing students to model positive/supportive behaviors that respect varying perspectives and viewpoints of others and yield consensus decision-making.

Digital Citizenship

5) Create a rubric for evaluating and selecting the best electronic communication tool for a given task or situation. Using scenarios from business and industry, identify appropriate tools for various situations and defend selections through a persuasive narrative, based on the application of the rubric.

6) Research and analyze various aspects of good digital citizenship. In groups, discuss the effects of technology on day-to-day and business communications. Select one topic (such as hacking of a customer database, social media, etc.) for further exploration and develop an electronic presentation employing to demonstrate the implications of the topic on society, as well as business and industry.

7) Compile significant points regarding courtesy and propriety in a digital business world ("netiquette") and prepare a presentation or web page that includes the topics of
    a. Message priority (urgent, normal, or low)
    b. Consent to share (property rights)
    c. Confidential or sensitive information (privacy)
    d. Message formatting (fonts, color, case, informal abbreviations, emoticons)

Business Writing

8) Evaluate, create, and revise business correspondence, short contracts and reports, electronic forms, and small legal documents for a business in standard English using the following:
    a. Employing word processing and simple spreadsheet programs
    b. Using proper grammar essentials, including parts of speech, vocabulary, punctuation, sentence structure
    c. Applying accepted business styles, including fonts, margins, layout, color, formats for dates, times, currencies, proper names
    d. Using acceptable business language, vocabulary, acronyms
    e. Writing for social media
    f. Writing for the internet

9) Analyze examples of writing for evolving digital platforms such as social media applications. Compare and contrast writing conventions required for commonly used applications and construct an event announcement for a local business in formats appropriate for at least three different social media/networking tools.

10) Locate a website used by a business to sell a product or service. Evaluate the website's design, content, text, images, layout, and color. Discern the site's effectiveness and ease of navigation, including the use of hyperlinks. Using persuasive writing, produce a critique addressing the pros and cons of the site, and offer recommended revisions.

Desktop Publishing

11) Create, adjust, and publish business document projects to typographic standards:
    a. Using word processing, spreadsheet, and desktop-publishing software
    b. Planning layouts based on estimation and calculations to achieve accepted balance of text, art, photos, and white space
    c. Applying consistent style standards, including fonts, margins, layout, color scheme, and image and text formats
    d. Inserting and formatting merged graphic elements, such as charts, graphs, photos and artwork, and text embellishments

e. Incorporating editing and revision markings to incorporate desired changes by the author/editor

12) Configure and send typographic output for designing camera ready documents on destination printer, color model (RGB, CMYK, etc.), preprint color requirement, and process color separations.

13) Manipulate, enhance and produce digital photographs, graphics, or other art elements utilizing photographic and / or graphic editing software.

Oral Communications

14) Draft and edit two speeches: (1) to persuade, and (2) to inform. Incorporate planning and preparation to deliver speeches that adhere to the following expectations:
    a. Appropriate for various audiences and purposes
    b. Delivered with enthusiasm and appropriate body language
    c. Structured to guide the listener to the desired objective or response
    d. Includes facts and research, in addition to original claim(s) and counterclaim(s) supported by evidence
    e. Revised based on peer feedback

15) Critique the purpose of various speaking assignments to identify the design and goal, such as to inform, educate, convince, persuade, or lead to action.

16) Plan, prepare, and conduct a short business meeting, including following-up after the meeting. Write an agenda, develop and produce necessary materials, facilitate the meeting effectively, and prepare a follow-up email thanking the attendees for their participation and summarizing key takeaways and action items.

17) Promote, organize, and practice creative problem-solving using the brainstorming approach, incorporating common techniques such as predefined time limits, short breaks, goals, visual aids, and record-keeping.

Virtual Meetings

18) Plan, organize, schedule, and deliver a webinar to one or more distant parties using computer conferencing tools (e.g., telephone or voice over IP, online conferencing system).
    a. Prepare an invitation, agenda, and overall script for the webinar, outlining the planned verbiage and business-related flow of information. Include guidelines, minutes and follow-up.
    b. Single-handedly or as a team, conduct the webinar or simulated webinar according to the agenda.
    c. Leverage the video, audio, and meeting enhancement tools available through the selected webinar software, such as highlighting, chat, polling, and question features to maximize audience interaction.
    d. Save, and edit, if needed, a short audio/video recording of the webinar for later publication.

19) Plan, organize, schedule, and conduct a web videoconference or simulation with one or more distant parties using computer conferencing tools (e.g., webcams, high-speed Internet, computer)
    a. Prepare an overall agenda for the web conference, outlining the planned exchanges of information, positioning and appearance of people, and switching between video sources (e.g., webcams, document cams, and other imagery).
    b. Follow the agenda to complete the web-meeting exchange, either single-handedly or as part of a team.
    c. Use effective communication and engagement strategies (such as effective meetings facilitation) to encourage active participation by all parties connected to the meeting.
    d. Save, and edit if needed, a short audio/video recording of the web meeting for later publication.

Career Activities

20) Prepare an electronic portfolio
    a. Including work products demonstrating career preparation skills, using an assortment of media (text, photos, video, hyper-linked pages).
    b. Including a professionally formatted résumé and other supporting documents such as cover letter and application.
    c. Packaged on a suitable media (e.g., CD, DVD, memory stick, web site).

21) Conduct a job search of positions in one or more career areas of interest using tools such as https://www.jobs4tn.gov and other online employment resources; complete a job application; participate in mock interviews with partner businesses and/or through participation in a student organization event.

22) Address the appropriate use of and ethics related to social media in personal and professional situations and its impact on career search processes, as well as its impact on the professional reputation of a person.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Accounting I

Primary Career Cluster:	Finance
Consultant:	Tara Campbell, (615) 253-7442, Tara.Campbell@tn.gov
Course Code(s):	5910
Prerequisite(s):	*Introduction to Business & Marketing* (5905)
Credit:	1
Grade Level:	10-11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Finance or Business Management & Administration courses.
Programs of Study and Sequence:	This is the second course in the *Business Management, Accounting,* and *Banking and Finance* programs of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual credit opportunities available for this course at specific community colleges. Reach out to a local postsecondary institution(s) for more information.
Teacher Endorsement(s):	030, 052, 054, 055, 152, 153, 158, 201, 203, 204, 311, 430, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-finance

Course Description

Accounting I is an essential course for students who wish to pursue careers in business and finance, or for those who wish to develop important skillsets related to financial literacy. Whether students aspire to be future business owners or work in finance with other companies, accounting skills are fundamental to success and applicable in many different fields. In this course, proficient Accounting students develop skills to analyze business transactions, journalize, post, and prepare worksheets and financial statements, and apply financial analysis to business processes. Additionally, students receive exposure to the ethical considerations that accounting professionals must face and the

standards of practice governing their work, such as the GAAP (generally accepted accounting procedures) standards. Upon completion of this course, proficient students will be prepared to apply their accounting skills in more advanced Business and Finance courses, and ultimately pursue postsecondary training.

Program of Study Application

This is the second course in the *Business Management, Accounting,* and *Banking and Finance* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Finance website at https://tn.gov/education/article/cte-cluster-finance.

Course Standards

Exploration of Accounting Careers

1) Define the role of accounting in business, and compare and contrast the various functions and roles of accountants and bookkeepers. Explain the importance of accounting in both for-profit and non-profit businesses.

2) Drawing on research from sources such as the American Institute of Certified Public Accountants (AICPA) and the Bureau of Labor Statistics (BLS), identify the skills needed to succeed in accounting and finance-related fields. Using real-time labor market data, investigate opportunities for job growth in these fields. Take a career interest inventory to assess goals and aptitudes, and develop a career plan based on the results.

3) Research authentic vacancy announcements for accounting professionals on online job boards or the websites of major companies. Compare interests and skills from the career interest inventory with the requirements listed in job descriptions, such as education credentials and work experience. Based on the research, develop a profile of one such position, detailing what the typical work day, salary, and responsibilities of a chosen accounting professional look like in a given location and/or sector of the financial industry.

Double-Entry Accounting Process

4) Define the double-entry accounting system. Examine the accounting equation and the rules of debit and credit. Categorize specific accounts (i.e., assets, liabilities, owner's equity, etc.) and analyze the impact of simple transactions on the accounting equation.

5) Using the fundamental steps of transaction analysis, demonstrate a thorough understanding of the accounting cycle by performing the following:
    a. Collect and analyze source documents, including invoices, receipts, memorandums, check stubs, and calculator tape
    b. Analyze each transaction
    c. Journalize each transaction and post to ledgers
    d. Prepare a trial balance and work sheet
    e. After journalizing, posting, and adjusting, prepare a post-closing trial balance
    f. Prepare financial statements (i.e., balance sheet, cash flow statement, income statement, change in equity statement, etc.)

For example, review sample transactions presented either through source documents or in narrative form, then determine what accounts are affected and whether they increase or decrease as a result of the transaction. Classify the accounts as assets, liabilities, or owner's (shareholders) equity, and create journal entries. Students should use both manual and computer based methods to develop accounting solutions in this course.

Analysis of Financial Data

6) Outline the major stages of the merchandising business cycle and review inventory control and payment terms (i.e., just-in-time [JIT] inventory, cash, trade, quantity, seasonal discounts, etc.). While examining the financial records of a business, determine the cost of merchandise inventory and cost of merchandise sold for a given range of products in a specified time period, analyzing the impact on business profitability. For example, perform simple "what if" analysis to determine the range of profitability, based on changing variables of the cost of merchandise sold and merchandise inventory in relationship to operating costs, such as salaries, equipment, supplies, and overhead.

7) Examine financial statements and analyze the effects of changing revenue and expenses on net income and assets. Identify trends within a company's financial information and compare and contrast present performance to past performance, as well as to industry competitors and overall averages. Evaluate the impact of basic changes in current assets, liabilities, revenues, and net income on liquidity and profitability. For example, an increase in the *cash in bank* account will drive an increase in the current and quick ratios (liquidity) of a company. Based on the analysis, develop business strategies to improve liquidity and profitability.

Key Business Processes

8) Explore cash control systems, and evaluate the importance of these systems to the security and stability of a business. Outline and demonstrate the steps for maintaining a checking account, including properly writing checks, tracking the check book balance, and reconciling that balance with the bank statement. Practice journalizing NSF (Not Sufficient Funds) checks, bank fees, and business credit card fees.

9) Compare and contrast different means of paying employees, evaluating which methods provide the best motivation to reach company goals. Establish a complete payroll system, including reviewing various means of tracking hours worked, completing a payroll register, preparing an employee earnings record, and cutting employee checks. Journalize and post for each account affected in the process.

10) Use the federal tax tables published by the Internal Revenue Service (IRS) to calculate the correct tax withholding for each employee, justifying the selection. Journalize and post to reflect the payment of the ongoing payroll liabilities, including Federal Income Tax, Social Security and Medicare taxes, Medical Insurance, and any other withholdings.

Ethics and Effective Business Communication

11) Analyze the need for strong ethics in the field of accounting and for ongoing reputable business operations. Determine how GAAP (generally accepted accounting principles) rules serve the business world and create a standard for building and evaluating financial statements. Conduct research on various fraud cases and report on how they were discovered. Submit an analysis on which of the GAAP rules were violated and write persuasively to describe what could have been done to prevent these frauds.

12) Develop and refine clear verbal and written communication techniques in order to properly describe and explain accounting methods and procedures. Practice narrating such procedures to mock "peer clients" as would a financial service professional, translating technical concepts into everyday language a potential customer could understand. Through small group projects and presentations, gain an understanding of the importance of teamwork and leadership, and model proper interpersonal business behavior needed to establish rapport and trust with clients.

Mock Accounting Review

13) Utilizing spreadsheet software, enter, organize, manipulate, calculate, and graph (by incorporating charts, graphs, and pivot tables) accounting data into professional spreadsheets. Integrate visual representations of data from spreadsheets into a professional presentation summarizing the financial position of a company, identifying the company's financial strengths and weaknesses.

14) As part of a collaborative or end-of-course project, conduct a mock accounting review to demonstrate workplace skills required in the profession. Interpret and analyze financial documents to derive accounting solutions. Prepare a glossary of key terms to help explain the recommendations and procedures, citing evidence from financial document analysis. Upon completion of the project, deliver a presentation or create a summary document demonstrating the ability to communicate the accounting process, explaining how procedures and principles were followed to achieve project goals.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Accounting II

Primary Career Cluster:	Finance
Consultant:	Tara Campbell, (615) 253-7442, Tara.Campbell@tn.gov
Course Code(s):	5911
Prerequisite(s):	*Accounting I* (5910)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Finance.
Programs of Study and Sequence:	This is the third course in the *Accounting* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org; FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual credit opportunities available for this course at specific community colleges. Reach out to a local postsecondary institution(s) for more information.
Teacher Endorsement(s):	030, 052, 054, 055, 152, 153, 158, 201, 203, 204, 311, 430, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-finance

Course Description

Accounting II is an advanced study of concepts, principles, and techniques used by businesses to maintain electronic and manual financial records. This course expands on content explored in *Accounting I* to cover the accounting processes of a variety of different firms, including merchandising, manufacturing, and service-oriented businesses. Upon completion of this course, proficient students will gain in-depth knowledge of business accounting procedures and their applications to business operations. Upon completion of this course, students will be prepared for postsecondary study and advanced training in accounting or business. Additionally, completion of this course can lead to a work-based learning (WBL) experience as the program of study capstone.

Program of Study Application

This is the third course in the *Accounting* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Finance website at https://tn.gov/education/article/cte-cluster-finance.

Course Standards

Accounting Processes and Operations

1) Demonstrate a thorough understanding of the accounting cycles of merchandising, manufacturing, and service businesses while performing actions necessary to plan, control, and evaluate business operations. Differentiate between inventory for both merchandising and manufacturing businesses and explain how the different types of businesses apply appropriate valuation methods when preparing financial statements.

Collection and Recording

2) Collect source documents used to track transactions in accounting processes, such as invoices, receipts, memorandums, check stubs, deposit slips, and electronic records. Describe the process used by a merchandising business to prepare, review, and analyze source documents as part of the accounting cycle, citing evidence from sample documents.

3) Maintain accurate and balanced records for all accounts analyzed throughout the duration of the course. Analyze source documents of increasing complexity within a variety of merchandising, manufacturing, and service operations. For a given transaction, determine debits and credits; journalize transactions in the general journal or special journals; post to the general ledger and subsidiary ledger accounts; and determine the ending balances of each account.

Finalization and Analysis of Data

4) Gather sample accounting worksheets from public records, textbooks, or other company templates to determine how merchandising businesses prepare financial records. Drawing on this information, prepare an original 10 column worksheet. Define and provide examples of key categories and terms, including accounts receivable, accounts payable, and various tax accounts.

5) Demonstrate accurate analysis of financial data by performing the following processes:
    a. Record and post adjusting entries to affected supplies, inventory, notes receivable, insurance, accounts payable, and tax accounts
    b. Prepare and analyze financial statements
    c. Record closing entries of temporary accounts, including revenue, expense, and withdrawals accounts
    d. Prepare the post-closing trial balance

For example, starting with a file of source documents and financial statements from the prior time period, complete a simulation or a mini-project spanning all steps in the accounting cycle for a merchandising business.

Accounting Applications and Implications

6) Compare and contrast the cost accounting records for a merchandising business with a manufacturing business.
    a. For a merchandising business, analyze the means of tracking and accounting for physical inventory and determining the actual cost of the merchandise resold to customers. Calculate the ending balance of the inventory account using the adjustment process
    b. In a manufacturing business, review the components of systems used to maintain records of manufacturing costs. Differentiate between job order and process cost accounting, and demonstrate an understanding of the advantages of each system for different manufacturing processes. Track the flow of inventory in the product process, from raw materials to work-in-process to finished goods inventory
    c. For both businesses, account for direct labor, direct material, and factory overhead budgeting

    For example, schedule a real or virtual field trip to a local manufacturing plant to observe how raw materials are converted to finished goods. Upon completion of the tour, prepare an informational text and accompanying graphic illustrating the cost accounting methods and budgeting practices employed by the firm.

7) Analyze an annual report for a service, merchandising, and manufacturing business, identifying the major sections and the implications of the financial data and statements included within the report. Illustrate through a formal financial presentation how the comparison of budgeted to actual revenue, expenses, and cash amounts affect management decision-making on matters such as budgetary planning, fiscal control policies, product line expansion, asset acquisition, downsizing, and operational improvements.

8) Examine various advanced applications of accounting for a merchandising business, and analyze the implications that each has for the business's profitability. Advanced applications include, but are not limited to, the following:
    a. Prepare adjustments for uncollectible accounts using both the direct write-off and the allowance method
    b. Analyze methods related to assigning cost to inventory, including the specific identification method, first-in first-out (FIFO) method, last-in first-out (LIFO) method, and weighted average cost method

    For example, calculate the cost of a business's inventory using all four inventory valuation methods and determine the effect on financial statements.

9) Define depreciation in accounting contexts, and determine the impact of depreciation on a variety of goods in different industries (i.e., manufacturing, agriculture, retail services, and more). For a selected firm in one of these industries, analyze and journalize acquisition, depreciation, and disposal of a plant asset, then calculate depreciation using the straight-line, declining balance, and sum-of-the-years digits methods.

Accounting in a Business Startup and Expansion

10) Research IRS.gov for multiple small business and self-employment forms/publications detailing important tax information related to the various stages of owning a business, from starting and filing for an Employer Identification Number (EIN), to operating and closing. Follow procedures to complete sample federal income tax employment/payroll forms (i.e., 940, 941, 944, W2) for small businesses, including social security and Medicare taxes, FUTA, and self-employment taxes. Prepare quarterly and end-of-tax-year examples for a real or fictitious small business.

11) Examine the steps required to form and expand a partnership. Analyze the transactions necessary for forming a partnership, admitting new partners, and distributing net income among partners, including identification of federal income tax forms for partnerships.

12) Explore the business model used by franchised companies. Compare and contrast depictions of the process used by companies to expand into a franchising business and the process used by franchisees to buy into the franchise. Analyze the financial obligations associated with franchised businesses for both the franchisor and the franchisee.

13) Investigate the process for incorporating a business. Accurately analyze practices and business forms related to the start-up of a corporation, including but not limited to stock subscriptions, dividends declaration, dividend payment, capital acquisition, and treasury stock. Include in the examination income tax filing requirements for corporations and note SEC (U.S. Securities and Exchange Commission) requirements for expansion of existing stocks in the process. Prepare an argumentative text intended for a simulated business which affirms the advantages of incorporating versus remaining a sole proprietorship or partnership.

Business Ethics

14) Investigate codes of ethics from professional organizations in accounting, personal finance, and banking and GAAP (Generally Accepted Accounting Principles) and examine areas of commonality. Synthesize principles from the codes investigated including separation of duties to create a personal code of ethics.

15) Examine real-world situations that involve ethical dilemmas and the application of correct professional conduct as highlighted in recent news articles. Craft an argumentative essay making a claim about the importance of ethics and professional standards for persons working in the accounting pathway, citing examples from case studies to argue for the relevance of professional codes of conduct.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Diagnostic Medicine

Primary Career Cluster:	Health Science
Consultant:	Sloan Hudson, (615) 532-2839, sloan.hudson@tn.gov
Course Code(s):	5994
Prerequisite(s):	*Health Science Education* (5998)
Credit:	1
Grade Level:	10-11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the second or third course in the *Diagnostic Services* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Pamela Sieffert, (615) 532-6270, Pamela.Sieffert@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Diagnostic Medicine is a second or third level course designed to prepare students to pursue careers in the fields of diagnostic medical imaging, medical laboratory testing, optometry, and other patient diagnostic procedures. Upon completion of this course, proficient students will be able to describe new and evolving diagnostic technologies, compare and contrast the features of healthcare systems, explain the legal and ethical ramifications of the healthcare setting, and begin to perform foundational healthcare skills. In addition, students will continue to add artifacts to a portfolio, which they will continue to build throughout the program of study.

Program of Study Application

This is the second or third course in the *Diagnostic Services* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Implementation options are as follows:

- Option 1: Diagnostic Medicine taught as a Level Two course
- Option 2: Diagnostic Medicine taught as a Level Three course

Core standards are required for both options above:
Core standards: 1,2,3,4,5,6,7,8,9,10,11,14,15,16,19,20,23,24,25,26,27,28,29,30,31

Additional standards:
Option 1: 12, 17, 21
Option 2: 13, 18, 22

Course Standards

Career Planning and Professionalism

1) Revise the career information portfolio developed in the *Health Science Education* course and update with more in-depth information surrounding careers in diagnostic sciences. Identify specific roles and responsibilities for each career in this field. Investigate and compare the range of skills, competencies, and professional traits required for such careers. Compare findings to current individual strengths and identify opportunities for personal development.

2) Summarize the Health Insurance Portability and Accountability Act (HIPAA), in particular those aspects related to maintaining confidentiality, patient rights, patient safety, and other ethical/legal directives governing medical treatment. Using medical terminology and accurate definitions of legal concepts, explain how the content of these ethical/legal ramifications affects patients' rights for all aspects of care.

Technology

3) Investigate and document the history of diagnostic medical imaging, medical laboratories, and other related areas of diagnostic medicine. Explain how technology, including telemedicine, is influencing the future of each. Synthesize research from professional journals and other medical or technical literature (noting the authors and their purposes) to analyze the barriers to these technologies and predict how the industry might respond.

4) Synthesize information from professional journals and digital resources to investigate the use of robotics in healthcare other than in surgical procedures. Develop a proposal, sketch, mock press release, or similar written artifact for a new technology or an improvement to a current technology that can be used in the field of diagnostics. Detail all the specifications of the new technology, including an explanation of how the technology will be used, the

projected cost-saving measures, and the most applicable professions that would use the technology.

5) Evaluate data from research articles encompassing the reliability of home testing kits (i.e., pregnancy test) and portable diagnostic equipment (i.e., glucometers). Explain findings in an informational essay, citing at least three different peer-reviewed articles and including appropriate medical terminology.

Safety

6) Obtain medical laboratory manuals from at least three different resources or physical laboratory sites. Identify the elements of containment regarding general infection control, chemistry precautions, fire safety, chemical hazards, electrical safety, mechanical safety, general lab safety, accident exposure, and disaster preparedness. Develop a written or digital lab manual for a medical laboratory at school based on findings from the research.

7) Research the guidelines pertaining to radiation safety for staff, patients, and family who are receiving any radiological procedure. Develop an informational artifact, public service announcement, or health education presentation that instructs patients/clients on what patients should know about medical radiation safety.

8) Explore policies and procedures related to diagnostic equipment quality control monitoring and evaluation. Synthesize information into a digital or written presentation to instruct appropriate staff on the importance of implementing quality control processes according to policy.

Infection Control/Medical Microbiology

9) Demonstrate mastery of concepts and skills related to asepsis, Universal Precautions, sanitation, disinfection, and sterilization for patient/client care settings in adherence to standards and guidelines from the Centers for Disease Control and Prevention (CDC) and the Occupational Safety and Health Administration (OSHA) in a lab/clinical setting.

10) Define the term normal flora and explain how its deviation can prevent or cause a disease or disorder. Outline specific preventive measures to align to acceptable standards of care in the healthcare field.

11) Assess the differences between healthcare-associated infections and non-healthcare-associated infections using examples drawn from mock patient documents or case studies. Support explanations with relevant surveillance statistics, preventive measures, and methodologies concerning outbreak detection, management, and education.

Diagnostic Medical Imaging

12) Outline the in-depth normal structure and function of the musculoskeletal, digestive, and cardio-respiratory systems, specifically as they relate to diagnostic medical imaging. Review directions, planes, and sections of the body in order to perform diagnostic medical imaging

procedures. Summarize appropriate medical text(s) in order to list signs and symptoms of common diseases and disorders associated with each system.

13) Outline the bony anatomy and organ structures of the musculoskeletal, digestive, and cardio-respiratory systems as they relate to diagnostic medical imaging. Review directions, planes, and sections of the body in order to perform radiographic images. Summarize appropriate medical text(s) in order to list signs and symptoms associated with and specific diagnostic studies used for common diseases and disorders associated with each system.

14) Distinguish between the various types of diagnostic medical imaging, citing the uses, advantages, and disadvantages of each. Develop an explanation that would be used for beginning health science students, incorporating appropriate industry and medical terminology.

15) Distinguish between Direct Radiography and Computed Radiography, citing the benefits of each related to the effects of radiation dose and cost. Compare the benefits of image storage in Picture Archive and Communication Systems to x-ray film storage. Relate the benefits of electronic image storage to its application in Telemedicine.

16) Research the principles of radiographic physics and explain how the concepts are applied to produce high-quality radiographic images. Discuss the following in the explanation:
    a. Properties of X-rays
    b. Production of X-rays
    c. The X-ray tube and other parts of an X-ray machine
    d. Absorption, scatter, and transmission of X-rays

Clinical Laboratory

17) Outline the in-depth normal structure and function of blood and related components. Summarize appropriate medical text(s) in order to list signs and symptoms of common blood diseases and disorders associated with each. Define the following common laboratory procedures, both normal and abnormal, and provide the reasoning for why the test should be obtained:
    a. Complete Blood Count
    b. Complete Metabolic Panel
    c. Fasting Lipid Panel
    d. Hgb A1C

18) Analyze the relationship of blood components to common blood diseases and disorders listing signs and symptoms associated with each. Define the following common laboratory procedures, both normal and abnormal, and provide the reasoning for why the test should be obtained:
    a. Complete Blood Count
    b. Complete Metabolic Panel
    c. Fasting Lipid Panel
    d. Hgb A1C

19) Develop a graphic organizer or concept map to explain the functions of the various departments of a medical laboratory, such as microbiology, chemistry, hematology, blood banking, and urology. Include types of fluid samples and test that are performed in each area with a detail of the precautions involved when handling each.

20) Understand principles of and successfully perform skills of a phlebotomist, incorporating rubrics from National HOSA, textbooks, or clinical standards of practice.
    a. Distinguish sites and/or veins for blood draws in all populations using the required equipment and safety precautions.
    b. Perform collection procedures for microspecimens and venipuncture on a mannequin using appropriate collection containers and identifying factors affecting collection/test results.
    c. Provide guidelines for obtaining blood from neonates, pediatrics, and geriatrics.
    d. Perform skills of patient/specimen identification and transporting of specimens.

Ophthalmological Procedures

21) Outline the in-depth normal structure and function of the eye. Summarize appropriate medical text(s) in order to list signs and symptoms of common diseases and disorders associated with each.

22) Summarize appropriate medical text(s) in order to compare and contrast normal versus abnormal structure and function of the eye related to common eye diseases listing signs and symptoms, and diagnostic studies for each.

23) Understand principles of and successfully perform skills related to basic ophthalmic examination, incorporating rubrics from textbooks or clinical standards of practice. Measure pulse and blood pressure, and conduct a history and physical, especially concerning areas related to the eye.

24) Research the concepts surrounding measurement of visual acuity with associated equipment, and explain corrective measures for abnormalities (i.e., surgery, glasses, or contacts). Specify what measures should be used with each abnormality.

Cardiologic Services

25) Research the educational requirements, certification, and licensures for cardiovascular technologist, diagnostic vascular technologist, electrocardiogram technician, telemetry technician, cardiac sonographers, and other related cardiovascular careers. Compare and contrast the educational requirements of each.

26) Investigate cardiac diagnostic procedures both in-hospital and out-patient and identify the equipment required for these services.

27) Create an infographic to identify gross heart anatomy and physiology and related cardiac conduction and circulatory pathways.

28) Assess lead placements and correlate their relationship to the conduction system through the use of a diagram or model.

29) Analyze the P,Q,R,S,T complex and its correlation to the cardiac cycle. Chart a mock representation of these waves on an electrocardiogram.

30) Analyze rhythm strips and/or 12 lead EKGs and differentiate between critical and non-critical cardiac rhythms using student created algorithms.

31) Assess and analyze cardiac output and tissue perfusion using capillary refill and/or pulse oximeter by assessing multiple classmates and correctly charting on flow chart.

The following artifacts should be included in the student's portfolio:

- Career exploration artifacts
- Skills performance rubrics
- Documentation of job shadowing hours
- Examples of written, oral, or digital presentations
- Short research project documents

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- National Accrediting Agency of Clinical Laboratory Sciences (NAACLS): Standards for Specific Approved Programs
    - Note: Students must be a completer of a NAACLS approved program in order to sit for a national phlebotomy certification exam.

Nutrition Across the Lifespan

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6005
Prerequisite(s):	*Introduction to Human Studies* (6137)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Human Services courses.
Programs of Study and Sequence:	This is the second course in the *Dietetics and Nutrition* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Nutrition Across the Lifespan is for students interested in learning more about becoming a dietitian, nutritionist, counselor, or pursing a variety of scientific, health, or culinary arts professions. Upon completion of this course, proficient students will understand human anatomy and physiological systems, nutrition requirements, as well as social, cultural, and other impacts on food preparation

and integrity. Artifacts will be created for inclusion in a portfolio, which will continue to build throughout the program of study.

Program of Study Application

This course is an applied knowledge course in the *Dietetics & Nutrition* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Human Services website at https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Safety & Sanitation

1) Compile and critique safety and sanitation procedures related to handling, preparing, storing, and serving food from industry-approved technical manuals and government published fact sheets. Identify and review general common laboratory safety procedures including but not limited to prevention and control procedures and personal hygiene expectations. Incorporate safety procedures and complete safety test with 100 percent accuracy.

Nutrition and Health Overview

2) Synthesize research published by government agencies or academic journals on the contribution of nutrition and exercise to achieving optimum physical, mental, and social well-being at all stages of development across the life span. Create an informative essay illustrating findings on the nutritional needs of individuals and families in relation to age, gender, activity level, and health status.

Anatomy and Physiology of Nutrition

3) Create a model or graphic illustration that identifies the major anatomic structures of the gastrointestinal (GI) system. Explain the function of each structure in the process of digestion, absorption, transport, and use of nutrients in the body. Research and develop a logical explanation of how the body deals with deficiencies and excess nutrients, citing specific textual evidence on the impact on an individual's health.

4) Identify, analyze, and visually represent the macro- and micro-nutrients required in the human diet. Include the common food sources of those nutrients, their chemical properties, and function in the body, as well as the influence upon biological systems in reference to maintenance and growth.
    a. Macro nutrients include: carbohydrates, lipids, and proteins
    b. Micro nutrients include: minerals, vitamins, and water

Nutritional Requirements Across the Lifespan

5) Accurately read, interpret, and communicate understanding of guidance from the U.S. Food and Drug Administration (FDA), and other regulators, such as nutrition labels and daily value

recommendations using accurate symbols, key terms, and other domain-specific words and phrases.

6) Research and prepare informational artifacts for consumers that present the specific nutritional guidelines for each stage of the life span using scientifically accurate terms and symbols. Life span phases should include:
    a. Birth to 1 year
    b. Toddlerhood
    c. Preschool
    d. School age
    e. Puberty and adolescence
    f. Pregnant and lactating females
    g. Early adulthood
    h. Middle adulthood
    i. Late adulthood

7) Analyze a variety of meal plans that meet nutritional requirements (caloric and RDA) as recommended by the U.S. Food and Drug Administration (FDA). Create a meal plan that addresses the nutritional needs of a specific individual based on their age, gender, activity level and other factors, and justify choices using evidence. Select, prepare, and serve food(s) from the meal plan following recipes precisely, including defining and utilizing specific culinary and measurement terms as needed. Practice proper serving and etiquette principles during appropriate situations.

8) Keep a food journal and compare an individual's diet to nutritional recommendations for their respective age, gender, activity level, and health status. Write a summary of the findings and include conclusions drawn on recommendations of how the diet could be modified to make up for deficiencies and excesses.

9) Compare and contrast alternative diet and lifestyle approaches to recommended dietary requirements for individuals of the same age and gender. Explain the reasons for the dietary differences in an informational artifact summarizing information to describe the physiological differences of the lifestyles, including, but not limited to:
    a. Differences in physical activity (i.e. athletic training)
    b. Differences in religious or ethical values (i.e. vegetarian, vegan, kosher)
    c. Differences based on disease or physiological need (i.e. gluten free, elimination or rotation diets)

Food Preferences and Choices

10) Research and summarize in an explanatory text the factors that contribute to food choices and preferences including cultural, geographical, economic, psychological, and societal influences. Describe the most likely results of preferences and external factors on nutritional intake.
    a. Example of geographical external factor on nutritional intake: Individual living in an area without adequate sunlight exposure may need to eat a diet rich in Vitamin D to make up for vitamin deficiency.

b. Example of geographical preference on food choice: Individual living in a colder climate might prefer methods of cooking that keep heat in the living area, while an individual living in a warmer climate might prefer preparation methods that reduce heat.

11) Form a hypothesis and design and conduct an experiment to identify the role of the senses and/or food preparation techniques in food choices. Summarize experiment results into an argument making a claim about the impact of variables on food choice. Compare results to findings in news media and note when findings support or contradict previous explanations or accounts.

12) Research nutritional claims of various diets and use appropriate/reliable sources of nutritional information to determine the validity of those claims. Use nutritional databases, food label information, and other sources to analyze the nutrient composition of one day of foods on each diet investigated. Create a graphic illustration comparing actual nutrition provided by each diet to the recommended nutrition requirements for an individual with specific characteristics, noting similarities and differences in two diets.

Nutritional Issues and Controversies

13) Synthesize evidence from multiple sources to analyze topics in nutrition, including but not limited to:
    a. The use of genetically modified foods
    b. Artificial sweeteners versus natural sugar
    c. Organic and local food movements
    d. Benefits and risk of different forms of dieting
    e. Use of probiotics

    Evaluate the validity and credibility of source materials and deduce the principle arguments for each, carefully weighing the author's evidence against potential biases.

14) Describe the correlation of energy balance, lifestyle, diet, age, gender, and metabolism to the obesity epidemic in America. Compare and contrast how different diets, habits, heredity, and physical characteristics contribute to obesity. Research various initiatives that have sought to fight obesity and improve nutrition across the nation. Summarize the intended result of an initiative in an explanatory essay, informational artifact, or presentation.

Food Preparation and Integrity

15) Investigate the food supply from point of origin to the point of sale – analyzing handling, transportation, storage, processing, and packaging – to identify where food safety and nutritional value could be compromised. Compare this to the food handling, transportation, storage, processing, and preparation from point of sale to the table by creating a graphic illustration indicating where food is most susceptible to contamination, food-borne illness, spoilage, and nutrient loss.

16) Demonstrate food selection and preparation methods that maximize the nutritional value of foods while minimizing dietary health risks. Plan and conduct nutrition laboratory

experiments to determine the physical and chemical changes of food structure through chemical reactions. Communicate results of experiences, including comparing and contrasting results to findings in a report. Demonstrate relationships among concepts including, but not limited to:

a. Heat
b. Acidity level
c. Fermentation
d. Millard reactions
e. Chemically processed foods
f. Preparation techniques and product yield

The following artifacts will reside in the student's portfolio:

- Illustration of Nutrition Needs
- Graphic or Model & Explanation of GI Tract
- Macro & Micro Nutrient artifact
- Informational Artifact for Consumers
- Analysis of Meal Plans
- Food Journal
- Food Preferences artifact
- Summarized Results from Food Prep Techniques Experiment
- Illustration of Nutrition Claims
- Nutritional Issues Comparison
- Food Integrity illustration
- Food Lab Reports

Standards Alignment Notes

*References to other standards include:

- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

TN Department of Education | College, Career and Technical Education

Computer Science Foundations

Primary Career Cluster:	Information Technology (IT)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6095
Prerequisite(s):	None
Credit:	1 credit for core and two focus areas. 2 credits for all 36 standards.
Grade Level:	9
Graduation Requirement:	This course satisfies one or two of three credits required for an elective focus when taken in conjunction with other IT courses.
Programs of Study and Sequence:	This is the first course in the *Networking Systems, Coding, Web Design*, and *Cybersecurity* programs of study.
Aligned Student Organization(s):	Future Business Leaders of America (FBLA) www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov SkillsUSA: http://www.tnskillsusa.com Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active work-based learning (WBL) Certificate issued by the Tennessee Department of Education may offer appropriate student placement. To learn more, please visit: https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	CompTIA IT Fundamentals
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	037, 041, 055, 056, 057, 152, 153, 203, 204, 311, 434, 435, 436, 470, 474, 475, 476, 477, 582, 595, 740, 742
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Course Description

Computer Science Foundations (CSF) is a course intended to provide students with exposure to various information technology occupations and pathways such as Networking Systems, Coding, Web Design, and Cybersecurity. As a result, students will complete all core standards, as well as standards in two of four focus areas. Upon completion of this course, proficient students will be able to describe various information technology (IT) occupations and professional organizations. Moreover, they will be able to demonstrate logical thought processes and discuss the social, legal, and ethical issues encountered in the IT profession. Depending on the focus area, proficient students will also demonstrate an understanding of electronics and basic digital theory; project management and teamwork; client relations; causes and prevention of Internet security breaches; and writing styles appropriate for web publication. Upon completion of the CSF course, students will be prepared to make an informed decision about which Information Technology program of study to pursue.

The following implementation options are encouraged:

- 1 credit for core and two focus areas (listed below)
- 2 credits for all 36 standards

Core standards are required for both one and two credit implementation options.

Core standards: 1, 2, 3, 7, 8, 9, 15, 16, 17, 18, 19, 20

Focus Areas	**Standards**
Networking Systems:	4, 5, 6, 10, 12, 13, 22, 23
Coding:	23, 33, 34, 35, 36
Web Design:	10, 11, 14, 21, 24, 25, 26, 27, 28
Cybersecurity:	13, 30, 31, 32

Program of Study Application

This is the first course in the *Networking Systems, Coding, Web Design, and Cybersecurity* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Safety

75) Accurately read, interpret, and demonstrate adherence to safety rules, including (1) rules published by the National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Internet safety, (4) Occupational Safety and Health Administration (OSHA) guidelines, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply.

76) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment.

Electronics and Basic Digital Theory

77) Demonstrate understanding of electrical circuits and devices, and relate to the physical laws (such as Ohm's Law and power laws) that govern behaviors of electrical circuits and devices. Accurately apply these physical laws to solve problems. For example, calculate the resistance of a DC circuit with a given DC voltage and current.

78) Assemble the required connections of electronic test equipment to properly test the operation of basic electronic circuit behavior and performance, using equipment such as a digital multimeter. For example, demonstrate the proper use of a digital multimeter by measuring resistance of a circuit in a typical computer system; compare this finding by calculating the resistance given the voltage and current.

79) Distinguish between the binary and hexadecimal counting systems. Using appropriate units, provide examples of each system and identify specific instances when IT professionals rely on them.

80) Explain the functions of gates in logic circuits (e.g., AND, OR, NOT). For example, construct a truth table for the seatbelt warning light in an automobile.

Career Exploration

81) Research various occupations in information technology industries, such as programmers, web designers, webmasters, networking administrators, computer systems administrators, telecommunications line installers, and informational security analysts. Compose an informative table or chart that includes the following: work activities typically performed, tools and technology used, nature of work environment, and the knowledge and skills needed for success.

82) Explore various professional societies related to information technology and identify the services and benefits provided by each member. Create a table that lists their purposes, benefits to membership, and any certifications affiliated with the organization. For example, investigate the Institute for Electrical and Electronics Engineers (IEEE), Computing Technology Industry Association (CompTIA), and the Association for Computing Machinery (ACM).

Overview of the Internet

83) Drawing on multiple sources (i.e., internet, textbooks, videos, and journals), research the history of the Internet. Create a timeline or infographic, illustrating the Internet's historical evolution from its inception to the present time. Discuss the needs that led to the creation of the Internet; discuss both the benefits and disadvantages of the Internet to society, as well as potential implications for the future. Provide examples drawn from the research to support claims.

Overview of Operating Systems

84) Drawing on multiple sources (i.e., internet, textbooks, videos, and journals), research the history and development of operating systems (e.g., Microsoft Windows, Linux, UNIX). Create a presentation, illustrating their historical evolution, from their inceptions to the present, citing information found in research. Compare and contrast the general capabilities of a variety of operating systems, and explain how their designs and functionalities have improved over time.

Terminology and Concepts

85) Demonstrate an understanding of basic web terminology and concepts. Practice explaining these terminologies and concepts by creating methods to help students learn and remember the information. For example, students should be able to explain the purpose of terminology such as server, domain name system (DNS) , internet service provider (ISP), hardware and software connective devices, cloud computing, remote access protocols, map protocols, content management systems (CMS), cascading style sheets (CSS), and social networking terms.

86) Demonstrate a basic understanding of computer hardware components. Identify these components using pictures or actual models and briefly explain the function of each. Components should include, but are not limited to:
    a. Hardware used for input and output
    b. Hardware inside the computer case
    c. Motherboard
    d. Processor and the chipset
    e. Storage devices (e.g., primary, secondary)
    f. Expansion cards
    g. Electrical system

87) Demonstrate a basic understanding of computer networking. For example, explain the types of networks and what a client-server environment is.

Keyboard Shortcuts

88) Identify, explain, and demonstrate the use of common keyboard shortcuts. Create a quick reference guide that would be user-friendly for a novice web designer. For example, students may create a multiple column table showing keyboard shortcuts for navigation, text editing, and text formatting. The table would identify which shortcuts are applicable to using Windows versus Mac OS.

Emerging Technologies

89) Synthesize research of historical and significant milestones that influenced the evolution of cloud computing. Create an annotated timeline or visual graphic illustrating significant time

periods and major impacts of technology trends that influenced the development of cloud computing. Use academic research and news media citing specific textual evidence from research.

90) Identify, describe, and effectively summarize cloud technology roles including: cloud computing customer, cloud service provider, and cloud service partner. Create a written report or visual depiction outlining the characteristics of each.

91) Research the features and requirements of the four main deployment models for cloud technology: public, private, community, and hybrid. Create a graphic illustration showing the roles of each and describe their differences.

92) Consult a variety of sources to describe how virtualization, storage, networking, and databases in cloud technologies are used. Sources may include textbooks, manuals, websites, video tutorials, and more. Create a visual display with accompanying text comparing these methods.

93) Explore the onset of the Internet of Things (IoT) and explain how it is enabled by sensors, actuators, communication devices and computers that exchange and process data and can interface with users in a most instinctual way. Using a specific example, summarize in a graphic illustration or narrative how the IoT combines information, automation, computation, software, sensing, and networking to make traditional processes more efficient.

94) Consult internet forums, textbooks, industry journals, and other instructional materials to research the importance of developing and implementing databases, data collection systems, data analytics, and other strategies that optimize statistical efficiency and quality. Write a brief paper that discusses the importance of these services in business today. Provide specific examples to support the claims.

Introduction to Logical Thought Process

95) There are different versions of the web design and development process. For example, most versions of the web design and development process involve project definition, site structure, visual design, site development, testing, refining, and launch. Using various resources, research, identify, and explain the steps involved in the process. As a class, develop an agreed-upon framework for applying the logical thought process to web design projects in the form of a flowchart or logic model, justifying the reasoning behind each step. Explain why it is an iterative process and always involves refinement.

96) Research, identify, and describe the specific activities involved at each step of the troubleshooting process, including by not limited to:1) gather information from the user or operator and back up data, 2) verify the problem exists, 3) isolate the cause of the problem and generate alternative solutions, 4) plan a solution and resolve the problem, 5) verify that the problem was resolved and prevent a future occurrence, and 6) document findings,

resolution, and preventative maintenance plan. Explain why it is important to document the process throughout.

97) Demonstrate an understanding of flowcharts and know what various symbols mean. Identify a problem that a programmer would solve using the logical thinking process, and create a flowchart that would guide the code development. For example, create a flowchart that incorporates at least three decisions, or paths, to solve a problem.

Teamwork & Project Management

98) Explore how teams are formed to complete and manage web design and development projects. Using the information gained from research, identify and explain various roles and responsibilities for members of a web design and development team. Include why teams are more efficient than individuals in the web design and development process. Present the findings to classmates.

99) Synthesize common principles and templates for successful project management. Explain, using examples, why strong management skills are important in the web design and development process.

Client Relations

100) Research and identify the skills that are required to communicate effectively with a client. Develop a questionnaire that would be used to determine the needs of a client for a prospective web development project. Using the questionnaire, conduct mock client interviews with classmates and provide each other with constructive feedback to revise the questionnaire and process.

Writing and Editing for Web Publication

101) As a team, list primary rules to guide writing content that is appropriate for a web site publication. Apply these rules to a variety of web-based writing assignments throughout the course. For example, develop and maintain a blog throughout the course to practice appropriate writing techniques and style for web publication.

102) Given a specific client's vision, create a simple web site using a content management system (CMS) such as WordPress. Follow the multistep process to download the software application of choice, and demonstrate how to upload and store files. Practice proofreading and critiquing other classmates' sites, and provide constructive feedback on one another's writing and layout design.

Social, Legal, and Ethical Issues

103) Drawing on multiple sources (i.e., internet, textbooks, videos, and journals), research the various social, legal, and ethical issues encountered by IT professionals. Using these findings, identify the roles and responsibilities one must consider while developing a

prospective project or addressing an IT problem. For example, web developers and programmers must apply copyright laws and understand uses of open source software.

Cybersecurity

104) Using various sources (i.e., internet, textbooks, videos, and journals), research and identify reasons as to why data security should be a priority to technology professionals through demonstrating an understanding of information security fundamentals on Confidentiality, Availability, and Integrity.

105) Demonstrate an understanding of the various security breaches that can occur with the Internet. Prepare a text explaining enterprise-level security, the purpose of encryption, and the protocols that can be implemented to secure web sites. Evaluate personal privacy issues versus employers' rights to regulate computing resources.

106) Identify various security practices for computer and network systems, such as how to control access to secured resources and computer resources. Give specific examples of methods that an administrator can use, like encryption techniques, basic input/output system (BIOS) features, and strategies for dealing with malware.

Organization of Materials

107) Understand and demonstrate the effective use of file and folder management techniques to maintain directory structure for a web site. Describe the most efficient methods for digital file management, including the use of site root and subfolders for assets (e.g., images, templates, CSS).

Programming

108) Explore and identify various languages, such as Python, HTML, PHP, C++, Visual Basic, Java, JavaScript, and C #. Explain how programmers use these languages to solve a variety of IT problems, furnishing examples of how they are applied.

109) Using various resources, research, identify, and explain the steps involved in the software development life cycle, including but not limited to: planning, designing, coding, testing, deployment, and maintenance. Explain why it is an iterative process and always involves refinement.

110) Demonstrate an understanding of how batch files function within a programming environment. Identify common commands to create code for batch files (e.g., title, echo, echo off, pause, CLS, ipconfig, and ping). For example, list various scenarios for using batch files to complete specific programming tasks. Create and execute batch file code to perform one of the tasks identified.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

TN Department of Education | College, Career and Technical Education

Entrepreneurship

Primary Career Cluster:	Marketing
Consultant:	Tara Campbell, (615) 253-7442, Tara.Campbell@tn.gov
Course Code(s):	5934
Prerequisite(s):	*Marketing & Management I: Principles* (5931)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	Completion of one credit of *Entrepreneurship* satisfies the *Economics* requirement for graduation. This course satisfies one of three credits required for an elective focus when taken in conjunction with other Marketing courses.
Programs of Study and Sequence:	This is the third course in the *Entrepreneurship* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/article/cte-cluster-marketing.
Available Industry Certifications	None
Dual Credit or Dual Enrollment	There are currently dual credit opportunities available for this course at specific community colleges. Contact a local postsecondary institution(s) for more information.
Teacher Endorsements	030, 035, 039, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-marketing

Course Description

Entrepreneurship is an applied knowledge course that begins with the discovery process of generating new business ideas. Students research local, national, and international social and economic trends and analyze the feasibility of their own proposed businesses, both from a market demand and revenue-producing standpoint. Based on their entrepreneurial endeavors, students will prepare, write, and revise a business plan. In preparation for the business plan, students will conduct market research, study ownership structures, evaluate risks, examine startup costs, determine essential vendors, and identify sources of capital and financing options. Students will also draft, refine, and rehearse entrepreneurship pitches developed from their business plans to present during course intervals and to give final presentations at the conclusion of the course. Upon conclusion of this course, proficient students will be able to articulate, and defend, elements of a full business plan for a new business.

Program of Study Application

This is the third course in the *Entrepreneurship* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Marketing website at https://tn.gov/education/article/cte-cluster-marketing.

Course Standards

This course is designed to provide a comprehensive outline and development of the necessary segments of a business plan for a startup venture. Standard 5 can be used to drive brainstorming and critical thinking to identify a potential business startup idea that students will continue to develop throughout the course. Students can approach this course individually or in teams, depending on background, knowledge and skills, and quality of business idea(s). Standards 6-17 should focus on the selected business startup idea and should be approached as parts of a larger whole rather than separate projects.

The Role of Entrepreneurs

1) Define the term *entrepreneur* and describe the key components of the entrepreneurial startup process (the entrepreneur, the environment, the opportunity, startup resources, and the new venture organization). Prepare an informative text to explain each component and identify the risks and rewards encountered in an entrepreneurial endeavor, highlighting the advantages and disadvantages of owning a business versus working for someone else.

2) Evaluate the role of entrepreneurship in the U.S. economy, and describe the expansion and growth of entrepreneurship in the current decade. Draw evidence from informational texts to examine how business cycles, economic indicators (i.e., interest rates, inflation, and unemployment) and free enterprise system characteristics such as profit motive, private property, and competition impact entrepreneurial decision making.

3) Research the backgrounds and business ventures of successful entrepreneurs to draw conclusions about the personal traits, experiences, and behaviors associated with entrepreneurship, including professional values and specific skills. Compare findings to personal strengths to assess potential for becoming a successful entrepreneur by

completing an entrepreneurial characteristics assessment and self-evaluation. Using the results of the self-assessment, identify areas of strengths and weaknesses and choose characteristics to develop. Prepare a written plan to further educational attainment, develop new skills, or seek work experience to develop identified skills.

4) Building on the research in Standard 3, select a well-known entrepreneur and summarize his/her strongest entrepreneurial characteristics, major business venture, and the problem the entrepreneurship sought to address with his/her venture. Analyze and cite any unique contributions to the U.S. economy or culture associated with the entrepreneur's endeavors. Make connections between information gathered during research and personal reflection from Standard 3.

Entrepreneurship Potential

5) Review news media and labor projections to identify current and projected trends in social and/or economic development, including but not limited to: web-based businesses, customer privacy, green businesses, social entrepreneurship, and more. In teams or individually, compile a list of potential ideas that have commercial potential not currently being met by existing businesses.

6) Analyze domestic and international opportunities for entrepreneurial ventures. Use the International Trade Statistics Yearbook of the United States, or other reliable sources, to research and locate the best global markets for a given product. Identify financial export assistance programs that U.S. government agencies and investment corporations offer; prepare a mock application for assistance following procedures and requirements.

Social and Ethical Responsibility

7) Examine different examples of business codes of ethics. Synthesize principles from the research, highlighting ethical problems typical for entrepreneurs such as conflicts of interests, bribes, and patent/copyright infringement. Create a written code of ethics for the proposed business.

8) Explore the growth of social responsibility in capitalism by reviewing news reports and journal articles about social entrepreneurship ventures. Create an informative text to define the term "conscious capitalism" and summarize how it is a growing business model for entrepreneurship.

Business Plan Development

9) Write, review, and revise a business plan for a potential entrepreneurial endeavor. The plan should include: an executive summary, company description, vision and mission statements, industry overview, market analysis, marketing plan, operations plan, and financial plan. Use resources such as the Small Business Administration (SBA), Service Corps of Retired Executives (SCORE), chambers of commerce, business incubators, and glencoe.com to locate and critically evaluate business plan templates.

10) Construct a market research project for the identified endeavor. Develop a research question, then determine, develop and conduct the appropriate research (primary research, secondary research, scientific method) to achieve the desired analysis. Summarize results of the research in recommendations in the business plan overview and market analysis.

11) Develop a customer profile with a detailed description of the potential target market for the proposed business based on demographic, geographic, psychographic, and behavioral information. Assess the viability of the profile for the proposed business by determining number of customers, reachability, and desire for product. Include these findings in the business plan's overview and market analysis section.

Marketing

12) Prepare a brief outline of the proposed business' marketing plan including pricing, promotion, and service/product planning in the development of customer relationships. Explain multiple pricing, promotions, and product selection strategies for the proposed business. Summarize how one or all of these strategies can directly impact a customer's experience.

13) Enhance the marketing plan with a proposal for attracting early adopters to the proposed product or service. Include ideas for preopening with the following objectives: establishing image, advertising methods, customer contact and interaction, generating appeal, and follow-up. Make a claim about the correct proportions of the marketing mix, supporting claim with data and evidence and addressing counterclaim(s) about alternative methods.

Operations

14) Compare and contrast the different ownership options for the proposed business,–sole proprietorship, partnership, corporation, not-for-profit, or franchise. Apply the analytical skills to determine the best type of ownership structure for the proposed business, justifying the rationale behind the choice. Identify the legal regulations required for the type of ownership selected. Prepare a sample partnership agreement or Doing Business As (DBA) document that outlines the division of assets, rights, and responsibilities of each owner.

15) Investigate channel management and distribution methods for the proposed product or service. Research possible manufacturers; study distribution considerations of the product or service, (including transportation, storage, handling, and packaging for products or staffing, training, and evaluation for services); cite justification for the channel management decisions, such as cost-saving benefits to the business' bottom line. Prepare a sample service contract with a potential vendor for first year of business.

Financials

16) Examine startup costs, operating costs, overhead, and personal expenses by researching and developing a financial statement based on models obtained from public records or business websites. Contact local lending institutions regarding requirements for business loans and needed documentation such as personal income statement, tax records, credit reports, loan history, and personal investment. Prepare financial statements and charts and graphs for the proposed business plan, including but not limited to:
    a. Estimated start-up costs
    b. Projected Income Statement
    c. Projected Balance Sheet
    d. Cash Flow

    Create a pro forma projection of a. – d. above. Establish length of view, i.e. first year, 3-year, 5-year timelines. Generate a breakeven analysis.

17) Investigate potential sources of startup capital needed to secure financing (e.g. equity financing, personal savings, angel investors, partnerships, venture capitalists, and debt financing) and list advantages and disadvantages of each. Visit or research local banks, entrepreneurship centers, or incubators to determine the most common reasons investors decline to invest in order to ensure business plan addresses typical concerns.

18) Prepare a "pitch" to explain the business to a potential investor, including breakdown of necessary financing and requested terms. Justify requested funding, using financial figures with appropriate data and evidence from coursework. Evaluate potential financing offers that may be different from requested terms. Based on the evaluation, choose to either accept or not accept the proposal. For example, based on startup costs needed and future valuation, pitch a request for $100,000 to a potential investor in return for a 25% stake in the proposed business. Then evaluate whether or not to accept a counteroffer of a proposed $100,000 for a 50% stake.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.