

Industrial Technology Mississippi Curriculum Framework

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The Office of Curriculum and Instruction (OCI) was founded in 2013 under the Division of Workforce, Career, and Technical Education at the Mississippi Community College Board (MCCB). The office is funded through a partnership with The Mississippi Department of Education (MDE), who serves as Mississippi's fiscal agent for state and federal Career and Technical Education (CTE) Funds. The OCI is tasked with developing statewide CTE curriculum, programming, and professional development designed to meet the local and statewide economic demand.

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ADOPTION OF NATIONAL CERTIFICATION STANDARDS

The **Accrediting Board for Engineering and Technology (ABET)** is a nonprofit, non-governmental organization that accredits college and university programs in the disciplines of applied science, computing, engineering, and engineering technology. ABET accredits over 3,300 programs at more than 680 colleges and universities in 24 countries. ABET provides specialized, programmatic accreditation that evaluates an individual program of study, rather than evaluating an institution as a whole.

ABET was founded in 1932 as the Engineers' Council for Professional Development (ECPD), an engineering professional body dedicated to the education, accreditation, regulation, and professional development of the engineering professionals and students in the United States. It was headquartered at the Engineering Societies Building and then the United Engineering Center in New York City until it relocated to Baltimore in 1996.

In 1936, ECPD evaluated its first engineering degree programs. Ten years later, the council began evaluating engineering technology degree programs. By 1947, ECPD had accredited 580 undergraduate engineering programs at 133 institutions.

Producing guidance and training publications was a large part of ECPD operations. The council produced dozens of books, pamphlets, brochures, and movies. Here are just a few of the many titles:

In 1997, following nearly a decade of development, ABET adopted Engineering Criteria 2000 (EC2000), considered at the time a revolutionary approach to accreditation criteria. EC2000 focused on what is learned rather than what is taught. At its core was the call for a continuous improvement process informed by the specific mission and goals of individual institutions and programs. Lacking the inflexibility of earlier accreditation criteria, EC2000 meant that ABET could enable program innovation rather than stifling it, as well as encourage new assessment processes and subsequent program improvement.

Today, the spirit of EC2000 can be found in the evaluation criteria of all ABET disciplines, and studies like Penn State's Engineering Change (PDF) prove those criteria are having an impact on accredited programs. ABET encourages the EC2000 perspective with other accreditation boards and degree programs, promoting global education and worker mobility through agreements like the Washington Accord, the Seoul Accord, and the Sydney Accord.

ABET accreditation, which is voluntary and achieved through a peer review process, provides assurance that a college or university program meets the quality standards established by the profession for which the program prepares its students. ABET is recognized by the Council for Higher Education Accreditation (CHEA).

ABET provides programmatic quality assurance for graduates of ABET-accredited programs who work in applied science, computing, engineering, and engineering technology and who are seeking professional recognition by enhancing their individual credentials through licensure, registration, and certification programs where appropriate.

For more information related to implementing ABET at your local campus, please visit <http://www.abet.org>.

INDUSTRY JOB PROJECTION DATA

Engineering technician occupations require an education level of an Associate of Applied Science degree. There is a 3.81% increase in occupational demand at the regional level and an 7.58% increase at the state level. Median annual income for engineering technicians is \$57,886.40 at the state and regional level. A summary of occupational data from the State Workforce Investment Board Data Center is displayed below:

Table 1: Education Level

Program Occupations	Education Level
Industrial Engineering Technicians	Associate Degree

Table 2: Occupational Overview

	Region	State	United States
2010 Occupational Jobs	451	499	61,330
2020 Occupational Jobs	492	563	64,015
Total Change	41	64	2,685
Total % Change	9.09%	12.83%	4.38%
2010 Median Hourly Earnings	\$21.72	\$21.72	\$23.18
2010 Median Annual Earnings	\$45,177.60	\$45,177.60	\$48,214.40
Annual Openings	4	6	268

Table 3: Occupational Breakdown

Description	2010 Jobs	2020 Jobs	Annual Openings	2010 Hourly Earnings	2010 Annual Earnings 2,080 Work Hours
Industrial engineering technicians	451	492	4	\$21.72	\$45,177.60
TOTAL	451	492	4	\$21.72	\$45,177.60

Table 4: Occupational Change

Description	Regional Change	Regional % Change	State % Change	National % Change
Industrial engineering technicians	41	9.09%	12.83%	4.38%

ARTICULATION

Secondary curriculum does not cover content to the same depth as the postsecondary curriculum; therefore, there is no statewide articulation agreement. Local agreements and dual credit partnerships are encouraged.

TECHNICAL SKILLS ASSESSMENT

Colleges should report the following for students who complete the program with a career certificate, technical certificate, or an Associate of Applied Science Degrees for technical skills attainment:

Autodesk AutoCAD Certified User Exam

http://www.certipoint.com/portal/DesktopDefault.aspx?page=common/pagelibrary/Autodesk_home.htm

ONLINE AND BLENDED LEARNING OPPORTUNITIES

Course content includes lecture and laboratory semester credit hours. Faculty members are encouraged to present lecture related content to students in an online or blended learning environment. Training related to online and blended learning will be available to faculty members through the MS Community College Board.

INSTRUCTIONAL STRATEGIES

The ABET standards were adopted and provide instructional strategies to faculty members implementing the curriculum.

ASSESSMENT STRATEGIES

The ABET Standards were adopted for the Industrial Technology curriculum and provide assessment strategies to faculty members implementing the curriculum. Additionally, standards were included in course content when appropriate.

CREDIT BY EXAMINATION

The following certification standards are aligned to courses listed below. Each test will serve as the state recommended exam to reward credit for prior learning experiences. Colleges have the local autonomy to create a college-level exam when awarding credit.

Course Number and Name	National Credential
ENT 1313 Principles of CAD	Autodesk AutoCAD Certified User Exam (with in the past 3 years)

PROGRAM DESCRIPTION

The Industrial Technology program is designed for students who want to prepare for employment leading to supervisor, administrative, and other management positions in the production areas of industry or into industrial distribution, wholesale level sales, distribution and/or installation of industrial products and equipment.

Upon successful completion of the curriculum, the graduate may earn a Career Certificate, Technical Certificate or an Associate of Applied Science Degree (AAS) in Industrial Technology. The curriculum also has the option of transfer to a four-year university, Mississippi State University, offering a related course of study from the College of Education, thereby leading to a Bachelor of Science Degree (BS) in Industrial Technology. Students will also be prepared to complete the Autodesk AutoCAD Certified User Exam.

SUGGESTED COURSE SEQUENCE

Accelerated Pathway Credential

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Clock Hours	Clock Hour Breakdown		Certification Information
			Lecture	Lab		Lecture	Lab	Certification Name
ENT 1313	Principles of CAD	3	2	2	90	30	60	
ENT 1213	Materials	3	2	2	90	30	60	
ENT 1113	Graphic Communications	3	2	2	90	30	60	
	Electives	6						
	TOTAL	15			270	90	180	

Career Certificate Required Courses

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Clock Hours	Clock Hour Breakdown		Certification Information
			Lecture	Lab		Lecture	Lab	Certification Name
ENT 1113	Graphic Communications	3	2	2	90	30	60	Autodesk AutoCAD Certified User Exam
ENT 1153	Basic Applications of Industrial Safety	3	2	2	90	30	60	
ENT 1223	Industrial Power Tools Applications*	3	2	2	90	30	60	
ENT 1313	Principles of CAD	3	2	2	90	30	60	
ENT 2343	Advanced CAD	3	2	2	90	30	60	
ENT 1533	Blueprint Reading	3	2	2	90	30	60	
ENT 2323	Industrial Welding and Metals*	3	2	2	90	30	60	
ENT 2363	Computer Numerical Control Drafting	3	2	2	90	30	60	
ENT 1813	Basic Electricity and Electronics***	3	2	2	90	30	60	
ENT 2613	Program Logic Controllers****	3	2	2	90	30	60	
	TOTAL	30			900	300	600	

* IMM 1224 Power Tools Application may substitute for ENT 1223 Industrial Power Tools Application

** IMM 1734 Maintenance Welding and Metals may substitute for ENT 2323 Industrial Welding and Metals

*** IMM 1814 Industrial Electricity Level I may substitute for ENT 1813 Basic Electricity and Electronics

**** IMM 2613 Programmable Logic Controls may substitute for ENT 2613 Program Logic Control

Technical Certificate Required Courses

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Clock Hours	Clock Hour Breakdown		Certification Information
			Lecture	Lab		Lecture	Lab	Certification Name
ENT 2443	Principles of Manufacturing Management	3	2	2	90	30	60	
ENT 2243	Cost Estimating	3	2	2	90	30	60	
ENT 1183	Spreadsheet Applications	3	2	2	90	30	60	
	Approved Technical Electives	6						
TOTAL		15			270	90	180	

General Education Core Courses

To receive the Associate of Applied Science Degree, a student must complete all of the required coursework found in the Career Certificate option, Technical Certificate option and a minimum of 15 semester hours of General Education Core. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester or provided primarily within the last semester. Each community college will specify the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college. The Southern Association of Colleges and Schools (SACS) Commission on Colleges Standard 2.7.3 from the Principles of Accreditation: Foundations for Quality Enhancement¹ describes the general education core.

Section 2.7.3 In each undergraduate degree program, the institution requires the successful completion of a general education component at the collegiate level that (1) is substantial component of each undergraduate degree, (2) ensures breadth of knowledge, and (3) is based on a coherent rationale. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours or the equivalent. These credit hours are to be drawn from and include at least one course from the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. The courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession.

¹

Southern Association of Colleges and Schools Commission on Colleges. (2012). *The principles of accreditation: Foundations for quality enhancement*. Retrieved from <http://www.sacscoc.org/pdf/2012PrinciplesOfAccreditation.pdf>

Technical Electives

Course Number	Course Name	Semester Credit Hours	SCH Breakdown			Total Clock Hours	Clock Hour Breakdown			Certification Information
			Lecture	Lab	Clinical/ Internship		Lecture	Lab	Clinical/ Internship	Certification Name
ENT 1123	Computational Methods for Drafting	3	2	2		90	30	60		
ENT 1213	Materials	3	2	2		90	30	60		
ENT 2243	Cost Estimating	3	2	2		90	30	60		
ENT 2263	Quality Assurance	3	2	2		90	30	60		
ENT 2723	Digital Studio	3	2	2		90	30	60		
ENT 2523	Preventative Maintenance and Service Equipment	3	1	4		135	15	120		
ENT 291(1-3)	Special Projects	1-3		2-6		60-180		60-180		
WBL 191(1-3) WBL 192(1-3) WBL 193(1-3) WBL 291(1-3) WBL 292(1-3) WBL 293(1-3)	Work-Based Learning	1-3			3-18	135-810			135-810	
	Other Instructor Approved Elective(s)									

CAREER CERTIFICATE REQUIRED COURSES

Course Number and Name: ENT 1113 **Graphic Communications**

Classification: Career Certificate Core Requirement

Description: This course is designed to give student fundamentals and principles of drafting to provide the basic background needed for all other engineering technology courses.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: Components of the Autodesk AutoCAD Certified User Exam

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Discuss classroom procedures and drafting occupations. .
 - a. Describe proper classroom/lab procedures
 - b. Describe the various occupations in drafting and their requirements.
2. Explain and apply safety rules and regulations. .
 - a. Describe safety rules for drafting occupations.
 - b. List and discuss hazardous materials found in the drafting area.
3. Apply proper techniques in technical drawings.
 - a. Demonstrate the ability to scale drawings.
 - b. Construct various angles.
 - c. Recognize and construct the alphabet of lines.
4. Sketch and develop views of basic shapes. .
 - a. Develop a pictorial view from three principal views.
 - b. Develop three principal views from a pictorial view.
 - c. Complete three principal views when lines are missing.
5. Use geometric constructions.
 - a. Construct tangent arcs and lines.
 - b. Divide lines or arcs into equal and/or proportional parts.
 - c. Develop geometric shapes.
6. Construct orthographic projections. .
 - a. Construct a top view, with front and right side views given.
 - b. Construct a front view, with top and right side views given.
 - c. Construct a right side view, with top and front views given.
 - d. Develop a drawing consisting of three principal views.

7. Dimension objects.
 - a. Recognize lines, symbols, features, and conventions used in dimensioning.
 - b. Recognize and use size and location dimensions.
 - c. Recognize and use general and local notes.
 - d. Dimension a drawing using contour, chain, and baseline dimensioning.

8. Construct sectional views.
 - a. Construct full and half sectional views.
 - b. Recognize and construct removed, revolved, offset, and aligned sectional views.

Course Number and Name: ENT 1153 Basic Applications of Industrial Safety

Classification: Career Certificate Core Requirement

Description: This course introduces the concepts of health and safety in engineering technology related fields. It aims to make the students safety conscious in relation to personal safety, accident prevention, and methods of compliance

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Introduction to basic safety and related laws.
 - a. Study various types of accidents.
 - b. Rights and responsibilities of employees and employers.
 - c. Learn concepts about OSHA and EPA regulations.
2. Introduction of the human element.
 - a. Introduction to specific job Personal Protection Equipment (PPE).
 - b. Study of ergonomics.
3. Hazard assessment, prevention, and control.
 - a. Introduction to chemical safety.
 - b. Introduction to tool safety.
 - c. Introduction to machine safety.
 - d. Introduction to electrical safety.
 - e. Introduction to safe materials handling.
4. Management of safety and health.
 - a. Introduction to electrical protection.
 - b. Introduction to basic fire protection.
 - c. Introduction to personal health protection.
5. Basic safe work practices.

Course Number and Name: **ENT 1223 Industrial Power Tool Applications**

Classification: Career Certificate Core Requirement

Description: This course is designed to teach students the safe and proper use of various hand and stationary power tools. This course includes instruction in the use of hand power tools, bench grinders, table saws, planer, cut-off saws, and drill presses.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: Components of the Autodesk AutoCAD Certified User Exam

Prerequisite: None

Student Learning Outcomes:

1. Demonstrate the safe and proper use of hand power tools.
 - a. Inspect, adjust, and operate hand power drills in a safe and proper manner.
 - b. Inspect, adjust, and operate hand cut-off saws in a safe and proper manner.
 - c. Inspect, adjust, and operate side grinders in a safe and proper manner.
 - d. Inspect, adjust, and operate circular saw in a safe and proper manner.
 - e. Inspect, adjust, and operate impact wrenches in a safe and proper manner.

2. Demonstrate the safe and proper use of a bench grinder.
 - a. Inspect, set up, and adjust a bench grinder for safe and proper use.
 - b. Sharpen twist steel drill bit.
 - c. Sharpen lathe tool bits.
 - d. Grind angles on metal.

3. Demonstrate the safe and proper use of a drill press.
 - a. Inspect, set up, and adjust a drill press for safe and proper operation.
 - b. Locate and drill holes in metal to specifications.
 - c. Ream holes to specifications.

4. Demonstrate the safe and proper use of a pipe threading machine.
 - a. Inspect, set up, and adjust a pipe threading machine for safe and proper operations.
 - b. Cut pipe to length.
 - c. Thread various diameters of pipe.

5. Demonstrate the safe and proper use of a cut-off saw.
 - a. Inspect, set up, and adjust a cut-off saw for safe and proper operation.
 - b. Service a cut-off saw blade to include removal, welding, installation, and tensioning.
 - c. Cut metal to length with a cut-off saw.
 - d. Cut angles on metal with a cut-off saw.

Course Number and Name: **ENT 1313** **Principles of CAD**

Classification: Career Certificate Core Requirement

Description: This course will use CAD to draw various problems in engineering related areas. Emphasis will be placed on the operations of the CAD system to solve drafting problems.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: Components of the Autodesk AutoCAD Certified User Exam

Prerequisite: None

Student Learning Outcomes:

1. Manage the operating system.
 - a. Examine the contents of storage devices.
 - b. List, erase, rename, and copy files on storage devices.
 - c. Examine, create, remove, and move files between folders and subfolders.
 - d. Access information services (e.g., Internet, e-mail, and networks).

2. Use the basic hardware of the CAD system.
 - a. Input data using keyboard and graphics tablet, or mouse.
 - b. Access files and/or symbols from the hard disk.
 - c. Store, retrieve, copy, and delete drawings and files.

3. Perform drafting functions on the CAD system.
 - a. Construct single-view and multi-view drawings.
 - b. Modify or edit an existing drawing.
 - c. Modify the existing system variables.

Course Number and Name: **ENT 2343 Advanced CAD**

Classification: Career Certificate Core Requirement

Description: This course is designed to give the student a continuation of CAD. Emphasis is placed on the user coordinate system and 3-D modeling.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: Components of the Autodesk AutoCAD Certified User Exam

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Manage 3-D solid models.
 - a. Create 3-D solid models.
 - b. Manipulate 3-D solid models.
 - c. Analyze 3-D solid models.

2. Manage the CAD system to improve productivity.
 - a. Perform customization to improve productivity.
 - b. Export data into computational software for manipulation.

Course Number and Name: **ENT 1533** **Blueprint Reading**

Classification: Career Certificate Core Requirement

Description: This course is designed to give the student terms and definitions used in reading blueprints. Basic sketching, drawing, and dimensioning of objects will be covered.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: Components of the Autodesk AutoCAD Certified User Exam

Prerequisite: None

Student Learning Outcomes:

1. Use the basic drawing equipment and terms used in sketching and making drawings.
 - a. Identify terms, symbols, and lines used in blueprints.
 - b. Utilize the basic equipment for sketching and/or drawing.

2. Interpret blueprints.
 - a. Identify the three basic views of a drawing.
 - b. Identify the various lines used on drawings.
 - c. Interpret dimensions and symbols.
 - d. Interpret general and specific notes on drawings.
 - e. Locate features on drawings.

Course Number and Name: ENT 2323 Industrial Welding and Metals

Classification: Career Certificate Core Requirement

Description: This course is designed to give the student Instruction in different metals and their properties using basic SMAW welding and oxy-fuel cutting and brazing.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: Components of the Autodesk AutoCAD Certified User Exam

Prerequisite: None

Student Learning Outcomes:

1. Discuss and apply proper safety procedures for welding.
2. Identify common metals, and discuss their properties.
 - a. Identify the following metals commonly used in industrial machinery: cold rolled steel, hot rolled steel, stainless steel, titanium, aluminum, brass, copper, and cast iron.
 - b. Discuss the properties of these metals as related to industrial maintenance.
3. Perform basic SMAW welding operations.
 - a. Practice safety procedures for SMAW welding operations.
 - b. Discuss the properties of electrodes commonly used in SMAW welding operations including E6010, E7018, stainless steel electrodes, and cast-iron electrodes.
 - c. Set up SMAW welding equipment for a specific job.
 - d. Prepare metal for SMAW welding.
 - e. Demonstrate basic elements and techniques used in SMAW welding, including speed, position, joint preparation, arc gap, and so forth.
 - f. Perform basic welding operations using SMAW welding equipment.
 - g. Fabricate a welding project to specifications.
4. Perform basic oxy-fuel cutting, welding, and brazing operations.
 - a. Practice safety procedures for oxy-fuel cutting and brazing operations.
 - b. Set up oxy-fuel equipment for cutting.
 - c. Set up oxy-fuel equipment for welding and brazing.
 - d. Perform oxy-fuel cutting operations on mild steel.
 - e. Perform oxy-fuel welding operations on mild steel.
 - f. Silver-braze or solder copper fittings to a copper line.
 - g. Heat metal for bending or component removal (bearings and races).

Course Number and Name: ENT 2363 Computer Numerical Control (CNC)

Classification: Career Certificate Core Requirement

Description: This course is designed to introduce the students to the basics of computer numerical control machines.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: Components of the Autodesk AutoCAD Certified User Exam

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Identify the basic functions of CNC.
 - a. List the advantages and disadvantages of CNC.
 - b. Define terms related to CNC machines.
2. Define the principles of the coordinate systems.
 - a. Define and discuss the Cartesian Coordinate System.
 - b. Define and discuss the Absolute Coordinate System.
 - c. Define and discuss the Incremental Coordinate System.
3. Identify the principles of the code system.
 - a. Identify the common code words.
 - b. Identify the common address formats.
4. Prepare and execute a basic CNC program.
 - a. Compute the tool length and cutter radii compensation.
 - b. Identify sub-programs.
 - c. Write a program for milling linear and circular cuts.
 - d. Write a program for a turning center.

Course Number and Name: ENT 1813 Basic Electricity and Electronics

Classification: Career Certificate Core Requirement

Description: This course is designed to give the student instruction in terminology and basic principles of electricity, use of test equipment, safety practices for working around and with electricity, and basic electrical procedures.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Discuss and apply proper safety procedures for industrial and electrical electronics.
 - a. Define terms related to electrical lockout/tagout applications.
 - b. Determine correct application of lockout/tagout on electrical enclosures, panels, and switching devices.
 - c. Discuss terms related to shop and tool safety.
 - d. Discuss terms related to AC safety and protection devices.
2. Apply basic terminology and principles associated with electricity.
 - a. Define terms related to electrical applications.
 - b. Practice safety precautions and procedures associated with electricity.
 - c. Identify and describe the use of fuses, ground-fault interrupters, breakers, and other safety devices associated with electrical circuits.
 - d. Apply Ohm's law to calculate circuit parameters including voltage, current, resistance, and power.
 - e. Discuss the effect of wire size on current and voltage in a circuit.
3. Develop the basic skills to analyze and construct electronic circuits.
 - a. Define and use symbols, abbreviations, and terminology found in industrial electrical work.
 - b. Calculate amperage for a given circuit.
 - c. identify basic series, parallel, and series parallel circuits.
4. To develop competencies in basic electronic fundamentals to problem solving techniques.
 - a. Measure current, voltage, and resistance in a circuit.
 - b. Test a circuit for continuity.
 - c. Tag out, disconnect, and reconnect an electric motor.
 - d. Perform preventive maintenance on an electric motor (disassemble, clean and inspect, lubricate, and reassemble).

Course Number and Name: ENT 2613 Programmable Logic Controllers

Classification: Career Certificate Core Requirement

Description: This course includes of programmable logic controllers (PLCs) in modern industrial settings. This course also includes the operating principles of PLCs and practice in the programming, installation, and maintenance of PLCs.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: Components of the Autodesk AutoCAD Certified User Exam

Prerequisite: None

Student Learning Outcomes:

1. Explain principles of PLCs.
 - a. Identify components and operational principles of PLCs.
 - b. Differentiate between a PLC and a computer.
2. Identify different types of PLC hardware.
 - a. Identify and wire different types of input and output modules.
 - b. Identify different types of PLC processor modules, memory capabilities, and programming devices.
3. Explain numbering systems, encoding/decoding, and logical operations.
 - a. Convert numbers from one system to another.
 - b. Explain logical operations using truth tables and ladder logic diagrams.
4. Program all types of internal and discrete instructions.
 - a. Program examine on and off instructions.
 - b. Program on-delay and off-delay instructions.
 - c. Program up-counter and down-counter instructions.
 - d. Program sequencer instructions for real-world output devices.
 - e. Program latch and unlatch instructions.
5. Troubleshoot and maintain programmable controller systems.
 - a. Identify and troubleshoot the power supply.
 - b. Identify and troubleshoot the inputs and outputs (I/O) cards.
 - c. Identify and troubleshoot real-world inputs and outputs.

TECHNICAL CERTIFICATE REQUIRED COURSES

Course Number and Name: ENT 2443 Principles of Manufacturing Management

Classification: Technical Certificate Core Requirement

Description: This course will include a study of manufacturing processes and materials. A problem solving approach will be used, emphasizing the context of the manufacturing business and the complexities to be addresses.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Describe the role of managers and management in an organization.
 - a. Define management terminology.
 - b. Identify economy changes and these influences on management decisions.
 - c. Outline society's expectations of managers and organizations.
2. Discuss the foundations of planning and decision-making.
 - a. Analyze the decision making process.
 - b. Identify methods of decision making by managers and groups.
 - c. Determine why planning is significant in organizations.
 - d. Identify how goals are set and plans are developed.
3. Describe the foundation of control and operations management.
 - a. Define control and why it is important to an organizations success.
 - b. Define Value Chain Management and its role in operations management.
4. Analyze scenarios pertinent to manufacturing business, taking into account production, organizational, and financial constraints.
5. Explore industrial manufacturing and the free enterprise system in which it operates.

Course Number and Name: ENT 2243 Cost Estimating

Classification: Technical Certificate Core Requirement

Description: This course is designed to give the student preparation of material and labor quantity surveys from actual working drawings and specifications

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Prepare a cost estimate of an assigned building.
 - a. Define the different types of estimates and specific purposes of each.
 - b. Prepare estimates of various kinds of foundations.
 - c. Estimate wall, ceiling, and roof frames.
 - d. Estimate exterior and interior finishes.
 - e. Estimate sub-contract items.
2. Discuss the best construction methods based on project requirements.
 - a. List the different types of construction in residential and commercial buildings.
 - b. Discuss the best method of construction in residential and commercial buildings.
3. Complete a materials list for a structure.
 - a. Describe the procedures of doing a materials list.
 - b. Explain the purposes for a materials list.
 - c. Complete a materials form for a construction project.

Course Number and Name: ENT 1183 Spreadsheet Applications

Classification: Technical Course Requirement

Description: This course focuses on applications of the electronic spreadsheet as an aid to management decision making.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: None

Pre-requisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate electronic spreadsheet applications.
 - a. Define terminology related to spreadsheet applications.
 - b. Design and format effective spreadsheets.
 - (1) Enter, edit, insert, delete, and move cell data.
 - (2) Find and replace cell data and formats.
 - (3) Apply and modify cell formats and row and column settings.
 - (4) Use automated tools in formatting.
 - (5) Use spell-check.
 - c. Create and revise formulas, using functions as well as relative and 3-D references.
 - d. Create, modify, position, print, and interpret charts and graphs.
 - e. Utilize the database functions of electronic spreadsheet software, including filtering, subtotals, and sorting using multiple fields.
 - f. Manage and customize spreadsheet files and folders.
 - (1) Create spreadsheets using templates, and save using different names and file formats.
 - (2) Insert and delete worksheets in a workbook, and modify worksheet names and positions.
 - (3) View and edit comments.
 - (4) Protect spreadsheets and spreadsheet elements.
 - g. Link and export data to word processing documents, presentations, and CAD drawings.

TECHNICAL ELECTIVE COURSES

Course Number and Name: ENT 1123 Computational Methods for Drafting

Classification: Technical Elective

Description: This course is designed to give the student a study of computational skills required for the development of accurate design and drafting methods.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Demonstrate various measurement methods.
 - a. Measure distances, including metric and English measurements.
 - b. Measure angles, including decimal degrees and degrees, minutes, and seconds.
2. Apply industry data.
 - a. Interpret graphs and charts.
 - b. Manipulate gathered information.
3. Analyze complex geometric shapes.
 - a. Solve basic algebraic equations and conversions from fraction to decimal and metric.
 - b. Calculate volume using metric and English systems.
 - c. Solve geometric construction based on area/volume solutions.
 - d. Calculate area using metric and English systems.
4. Calculate trigonometric values.
 - a. Calculate angle values of a triangle.
 - b. Solve geometric construction based on angular solutions.

Course Number and Name: **ENT 1213 Materials**

Classification: Technical Elective

Description: This course is designed to teach students physical properties of the materials generally used in the erection of a structure and the manufacture of products, with a brief description of their manufacture.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Describe the uses of wood components.
 - a. Identify and describe diseases and lumber defects.
 - b. Identify different types of lumber and their design factors.
 - c. Identify and describe plywood and panel products and their design factors.
 - d. Identify and describe products manufactured from wood and their design factors.
 - e. Identify and describe heavy timbers and their design factors.
 - f. Identify fire retardant treatments.

2. Describe concrete characteristics.
 - a. Describe the use of common and special types of concrete.
 - b. Classify aggregates.
 - c. Explain how the design and control of concrete is maintained.
 - d. Describe the psi rating system for concrete.
 - e. Review and describe the design applications of admixtures.
 - f. Identify and explain typical concrete test applications.
 - g. Identify and describe common concrete masonry units.
 - h. Explain concrete batching, transportation, handling, placement, finishing, and curing.

3. Describe the characteristics of ferrous metals.
 - a. Describe the manufacturing processes of steel.
 - b. Review and describe the design applications of ferrous metals.
 - c. Identify and describe steel identification systems.
 - d. Identify and describe metal testing methods.

4. Describe the characteristics of nonferrous metals.
 - a. Describe the manufacturing processes of aluminum and other nonferrous metals.
 - b. Review and describe the design applications of nonferrous metals.
 - c. Identify and describe identification systems of nonferrous metals.
 - d. Identify design solutions to minimize galvanic corrosion.

5. Describe the characteristics of plastics.
 - a. Describe the manufacturing processes of plastics.
 - b. Review and describe the design applications of admixtures.
 - c. Identify and describe multiple types of plastic.

6. Describe various materials used in manufacturing and construction.
 - a. Identify and describe different types of protective coatings.
 - b. Identify and describe different types of insulating materials.
 - c. Identify and describe gypsum products and materials.

Course Number and Name: ENT 2263 Quality Assurance

Classification: Technical Elective

Description: This course focuses on the application of statistics and probability theory in quality assurance programs. Various product sampling plans as well as the development of product charts for defective units will be studied.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: None

Pre-requisite: None

Student Learning Outcomes:

1. Utilize basic quality assurance procedures.
 - a. Discuss the history, development, and current trends of quality assurance and the use of quality circles.
 - b. Describe the concept of probability.
 - c. Compute the following measurements of central tendency: mean, median, and mode for a given set of data.
 - d. Describe the frequency distribution for a normal population.
 - e. Distinguish among the terms "accuracy," "precision," and "accuracy and precision."
 - f. Compute the standard deviation and the square of the residuals for a given set of data.
2. Effectively use sampling techniques.
 - a. Describe the process of random sampling as applied to quality assurance.
 - b. Compare single and multiple sampling plans.
 - c. Describe the characteristics of the sampling plans.
3. Effectively use various charts.
 - a. Describe the general theory of a control chart.
 - b. Describe the development and use of fraction defective charts.
 - c. Discuss special applications of control charts.
 - d. Apply quality assurance procedures in a laboratory setting.

Course Number and Name: ENT 2723 Digital Studio

Classification: Technical Elective

Description: This course is designed to give the student a general overview of current issues in digital media; a study of how digital media can assist in the work environment; provides a basis for further study in graphic design and production.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	90

National Assessment: None

Pre-requisite: Instructor Approved

Student Learning Outcomes:

1. Produce multimedia pictures using multimedia software with a scripted presentation.
 - a. Define terms associated with multimedia.
 - b. Sketch a layout of a multimedia presentation.
 - c. Explain the use of the software.
 - d. Develop a picture using the software.
 - e. Compose a script.
 - f. Deliver a presentation.
2. Construct computer-generated animation.
 - a. Define terms associated with computer-generated animation.
 - b. Identify animation software.
 - c. Create an animation storyboard.
 - d. Prepare and present a computer-generated animation project.
3. Research and develop projects that are a culmination of training specifically related to the Engineering industry.
 - a. Investigate and formulate conceptual ideas for industry needs.
 - b. Employ computer-generated graphics to create professional artwork to meet industry needs.
 - c. Manipulate current software to generate graphics to meet industry needs.
4. Create an electronic portfolio.
 - a. Develop a resume.
 - b. Create images of program projects.
 - c. Organize in a digital format to be used for employment or transferability purposes.

Course Number and Name: ENT 2523 Preventative Maintenance and Service of Equipment

Classification: Technical Elective

Description: This course is designed to give the student instruction in basic maintenance and troubleshooting techniques; use of technical manuals and test equipment; and inspection, evaluation, and repair of equipment.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	1	4	135

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Discuss and apply proper safety procedures regarding preventative maintenance and service of equipment.
2. Perform preventative maintenance on equipment.
 - a. Develop a preventive maintenance program for a given piece of equipment.
 - b. Inspect and adjust belts, chains, and other moving parts.
 - c. Lubricate a machine following manufacturer's recommendations.
3. Troubleshoot and repair equipment.
 - a. Identify symptoms that indicate a machine is not operating properly (excessive noise, vibration, heat, speed, etc.).
 - b. Determine the cause of the symptoms.
 - c. Inspect machinery for broken or worn parts, and determine if replacement is needed.
 - d. Prepare a report on time and costs involved in repairing equipment, including shutdown time for the machinery.
 - e. Perform lockout–tagout procedures for broken equipment.
 - f. Disassemble, inspect, repair, and reassemble equipment to specifications.

Course Number and Name: ENT 291(1-3) Special Project

Classification: Technical Elective

Description: This course is designed to give the student practical application of skills and knowledge gained in other drafting courses. The instructor works closely with the student to ensure that the selection of a project will enhance the student's learning experience.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
1		2	60
2		4	120
3		6	180

National Assessment: None

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Develop a written plan that details the activities and projects to be completed.
 - a. Utilize a written plan that details the activities and projects to be completed.
 - b. Perform written occupational objectives in the special project.
2. Assess accomplishment of objectives.
 - a. Prepare a weekly written assessment of accomplishment of objectives.
 - b. Present weekly written reports of activities performed and objectives accomplished to the instructor.
3. Utilize a set of written guidelines for the project.
 - a. Develop and follow a set of written guidelines for the special project.

RECOMMENDED TOOLS AND EQUIPMENT

Capitalized Items

Access to some tools and equipment may be provided by Machine Shop, Electrical, Plumbing/Pipefitting, Automotive, Welding, HVAC & Industrial Maintenance Program facilities.

1. Computer workstation with AutoCAD (or other design software) (20)
2. PLC Trainers (10) (need access to computers)
3. CNC Mills (5) (need access to computers)
4. CNC Lathes (5) (need access to computers)
5. Electronic/Electricity Trainers (10) (need access to computers)
6. 3D extrusion printer (5) (need access to computers)
7. Laser jet printer (2)
8. Scanner (1)
9. Emergency eyewash station (1)
10. Work bench with heavy duty mechanics vises (5)
11. Work area protective screens (1 per booth)
12. Exhaust system welding lab (1)
13. Vacuum system in power tools lab if applicable (1)
14. Compressed air delivery system (compressor, lines, hoses, air regulator, quick connectors, adapters) (1)
15. Compress Air Dryer (1)
16. Shielded metal arc welding machine (AC-DC) with cables and accessories (6)
17. Welding Rod Oven (1)
18. Oxy-fuel welding, brazing, and cutting equipment with regulators, hoses, torch and tips, cart, and accessories (6) (adaptable to manifold system if applicable)
19. Horizontal band saw (1)
20. Metal drill press with accessories (vise, collets, hold down clamps) (1)
21. Pedestal grinders (2)
22. Tap and die set (1)
23. Outside micrometer (10)
24. Dial caliper (10)
25. Depth micrometer (2)
26. Hand tool sets (wrenches, sockets, socket accessories, screwdrivers, hammers, punches, chisels, pliers, allen wrenches, feeler gauges, files, adjustable wrenches, etc....) (5)
27. Pipe threading machine with accessories (1)
28. Chain hoist on portable a-frame or overhead trolley (2)
29. Hoisting accessory kits (pulleys, chains, wire robe, clamps, block and tackle, come-alongs, shackles, hooks, tie-downs, etc....) (1)
30. Hydraulic jacks (2)
31. Jack stands (2)
32. Abrasive cut-off saw (1)
33. Fiberglass step ladder (3 at various heights) (1 of each)
34. Four-wheel heavy duty dolly (1)
35. Impact wrench with impact sockets (2)
36. Stationary belt sander (1)
37. Vertical band saw (1)
38. MIG welders with accessories (2)
39. Plasma cutter (1)
40. Reciprocating saw (2)
41. Hammer drill (2)
42. Radial miter saw (1)
43. Table saw (1)

44. Planer (1)

Non-Capitalized Items

1. Architectural, Engineer, Decimal, Metric scales (20 per category)
2. 4.5" right angle grinder (4)
3. 9" right angle grinder (1)
4. First aid kit (1 per lab)
5. Leather jacket, sleeves, leather gloves, apron etc... (8 sets)
6. Welding helmets (2 per machine)
7. Welding goggles (2 per oxy-fuel setup)
8. Hole saw set (3/8" – 2") (2)
9. Safety glasses with side shields, safety goggles, face shields (1 pair per student minimum)
10. Sanitizing cabinet (1)
11. Drill bit set (2)
12. Combination square set (8)
13. Bevel square (6)
14. Rafters Square (3)
15. Torpedo level (5)
16. Carpenter level (2)
17. Hand hack saw (5)
18. Cross cut and rip hand saw (4 each)
19. Cordless drill with charger (3/8") (4)
20. Pipe wrench set (6"-18") (2)
21. Electrical hand tool set (lineman's pliers, wire stripper, screwdriver, needle nose plier, nut drivers) (4)
22. Digital Volt Ohm meter (6)
23. Adjustable wrench set (2)
24. Lockout/tagout station (1)
25. Chipping hammer (8)
26. Wire brushes (10)
27. Clamp on amp meter (2)
28. Circular(skill) saw (5)
29. Jigsaw (3)
30. Pedestal Disk Sander (1)
31. Hand held belt sander (3)
32. Metal scribe (10)
33. Nail Set (4)
34. Nibbler (1)
35. Straight, right and left angle hand shears (2 of each)
36. Pliers (vise grip, adjustable, channel lock, etc....) (4 each)
37. Welding vise grips (2 per welding station)
38. Assorted angle welding magnet holders (2 per station)
39. 25' tape measure (20)
40. 100' tape measure (5)
41. Wood folding rule (10)
42. 7.5" speed square (6)
43. Nail gun (2)
44. Staple gun (1)
45. Brad gun (1)
46. Soapstone
47. Chalk Line & Chalk
48. Pipe Bender
49. Hand Pipe Cutter
50. Plumb bob (1)

RECOMMENDED INSTRUCTIONAL AIDS

It is recommended that instructors have access to the following items:

1. TV monitor (1)
2. VCR/DVD player (1)
3. AV cart (1)
4. Projection screen (1)
5. Overhead projector (1)
6. Teacher computer with printer (1)

CURRICULUM DEFINITIONS AND TERMS

- Course Name – A common name that will be used by all community colleges in reporting students
- Course Abbreviation – A common abbreviation that will be used by all community and junior colleges in reporting students
- Classification – Courses may be classified as the following:
 - Career Certificate Required Course – A required course for all students completing a career certificate.
 - Technical Certificate Required Course – A required course for all students completing a technical certificate.
 - Technical Elective – Elective courses that are available for colleges to offer to students.
- Description – A short narrative that includes the major purpose(s) of the course
- Prerequisites – A listing of any courses that must be taken prior to or on enrollment in the course
- Corequisites – A listing of courses that may be taken while enrolled in the course
- Student Learning Outcomes – A listing of the student outcomes (major concepts and performances) that will enable students to demonstrate mastery of these competencies

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75% of the time allocated to each course. The remaining 25% of each course should be developed at the local district level and may reflect the following:
 - Additional competencies and objectives within the course related to topics not found in the state framework, including activities related to specific needs of industries in the community college district
 - Activities that develop a higher level of mastery on the existing competencies and suggested objectives
 - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed or revised
 - Activities that include integration of academic and career–technical skills and course work, school-to-work transition activities, and articulation of secondary and postsecondary career–technical programs
 - Individualized learning activities, including work-site learning activities, to better prepare individuals in the courses for their chosen occupational areas
- Sequencing of the course within a program is left to the discretion of the local college. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors. Programs that offer an Associate of Applied Science Degree must include all of the required Career Certificate courses, Technical Certificate courses **AND** a minimum of 15 semester hours of General Education Core Courses. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester. Each community college specifies the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college.

- In order to provide flexibility within the districts, individual courses within a framework may be customized by doing the following:
 - Adding new student learning outcomes to complement the existing competencies and suggested objectives in the program framework
 - Revising or extending the student learning outcomes
 - Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the Mississippi Community College Board [MCCB] of the change)