2008 Mississippi Curriculum Framework

Postsecondary Process Operations Technology

(Program CIP: 15.0699 – Industrial Production Technologies/Technicians, Other)

Direct inquiries to

Debra West, Ph.D.
Director for Career and Technical Education
State Board for Community and Junior Colleges
3825 Ridgewood Road
Jackson, MS 39211
(601) 432-6518
dwest@sbcjc.cc.ms.us

Jimmy McCully, Ph.D.
Instructional Design Specialist
Research and Curriculum Unit
P.O. Drawer DX
Mississippi State, MS 39762
(662) 325-2510
jimmy.mccully@rcu.msstate.edu

Additional copies

Research and Curriculum Unit for Workforce Development
Vocational and Technical Education
Attention: Reference Room and Media Center Coordinator
P.O. Drawer DX
Mississippi State, MS 39762
https://cia.rcu.msstate.edu/curriculum/download.asp
(662) 325-2510

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Research and Curriculum Unit for Workforce Development
Vocational and Technical Education
Mississippi State University
Mississippi State, MS 39762

Acknowledgments

Writing Team

Tommie Broome, Mississippi Gulf Coast Community College, Perkinston, MS

RCU Staff

Jimmy McCully, Ph.D., Coordinator of Agriculture and Special Initiatives
Jo Ann Watts, Instructional Design Specialist

Professional Curriculum Advisory Team

Ernest Malone, Chevron, Pascagoula, MS
Joe Neville, Chevron, Pascagoula, MS
William Wieniwitz, Chevron, Pascagoula, MS
Terrell Taylor, First Chemical, Pascagoula, MS
Stephen Richardson, BP, Pascagoula, MS
Marc Holman, DuPont, Moss Point, MS
F. D. Diaz, Southern Company, Gulfport, MS
Mary Franklin, Southern Company-Alabama Power, Birmingham, AL
Amanda Helms, Chevron NAEPC, New Orleans, LA
Clay Williams, BP Deepwater, Horn Mountain Spar
Louis E. Poore, Shell – A&R Americas, New Orleans, LA
Darwin Stillson, Gulf LNG, Pascagoula, MS
Harry Wood, Gulf Coast Process Technology Alliance, Lake Jackson, TX
Merv Treigle, Center for the Advancement of Process Technology, Texas City, TX

Standards in this document are based on information from the following organizations:

Center for the Advancement of Process Technology Standards

Center for the Advancement of Process Technology. (2005). *Chemical/Refining Technician Skill Standards*.

Related Academic Standards

CTB/McGraw-Hill LLC. (1994). *Tests of adult basic education, forms 7 and 8.* Monterey, CA: Author. Reproduced with permission of CTB/McGraw-Hill LLC. TABE is a registered trademark of The McGraw-Hill Companies, Inc. Copyright © 1994 by CTB/McGraw-Hill LLC. Reproduction of this material is permitted for educational purposes only.

21st Century Skills

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Preface

Process Operations Technology Research Synopsis

Process Operations Technology programs were established at the request of industries on the Mississippi Gulf Coast in response to a recognized critical need for process operations technicians in the petrochemical and power generation industries. The program was implemented in the fall semester of 2003 at the Perkinston Campus of Mississippi Gulf Coast Community College. Ms. Tommie Broome, the instructor, holds an associate's degree from MGCCC and is pursuing a baccalaureate degree in Technical and Occupational Education from the University of Southern Mississippi. Ms. Broome has 23 years of experience as a process operations technician.

Content of the process operations courses is based on the curriculum developed by the Center for the Advancement of Process Technology (CAPT) located at the College of the Mainland near Galveston, TX. CAPT was founded in 2002 specifically for the purpose of developing curriculum and instructional materials for technical and community colleges and the process operations industry. All courses in the CAPT curriculum were developed with direct input from the process operations industry. The courses and materials are now being used in associate degree programs in 23 states and 49 technical and community colleges. Thirty-five different companies are now affiliated with CAPT.

Courses for the Mississippi Curriculum Framework for Process Operations Technology were reviewed and endorsed by representatives of major industries on the Gulf Coast. Chevron, BP, Shell, Mississippi Power, Entergy, and Southern Company have taken an active interest in the program by sponsoring scholarships, internships, and mentoring opportunities for students and by providing equipment and supplies. A Craft Committee composed of industry representatives meets regularly to review the program and make comments and recommendations.

Curriculum
The following national standards were referenced in each course of the curriculum:

- Center for the Advancement of Process Technology, *Chemical/Refining Process Technician Standards*
- CTB/McGraw-Hill LLC *Tests of Adult Basic Education, Forms 7 and 8* Academic Standards
- *21st Century Skills*

Assessment
Students will be assessed using the *Mississippi Career Planning and Assessment Process Operations Technology* test.

Professional Learning
It is suggested that instructors participate in professional learning related to the following concepts:

- Institutes, conferences, and other professional development activities sponsored by the Center for the Advancement of Process Technology

- Differentiated instruction – To learn more about differentiated instruction, please go to http://www.paec.org/teacher2teacher/additional_subjects.html, and select Differentiated Instruction. Work through this online course, and review the additional resources.

Articulation
No articulated credit will be offered upon implementation of this curriculum by the college.

Foreword

As the world economy continues to evolve, businesses and industries must adopt new practices and processes in order to survive. Quality and cost control, work teams and participatory management, and an infusion of technology are transforming the way people work and do business. Employees are now expected to read, write, and communicate effectively; think creatively, solve problems, and make decisions; and interact with each other and the technologies in the workplace. Vocational–technical programs must also adopt these practices in order to provide graduates who can enter and advance in the changing work world.

The curriculum framework in this document reflects these changes in the workplace and a number of other factors that impact local vocational–technical programs. Federal and state legislation calls for articulation between high school and community college programs, integration of academic and vocational skills, and the development of sequential courses of study that provide students with the optimum educational path for achieving successful employment. National skills standards, developed by industry groups and sponsored by the U.S. Department of Education and Labor, provide vocational educators with the expectations of employers across the United States. All of these factors are reflected in the framework found in this document.

Referenced throughout the courses of the curriculum are the 21st Century Skills, which were developed by the Partnership for 21st Century Skills, a group of business and education organizations concerned about the gap between the knowledge and skills learned in school and those needed in communities and the workplace. A portion of the 21st Century Skills addresses learning skills needed in the 21st century, including information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills. The need for these types of skills has been recognized for some time, and the 21st Century Skills are adapted in part from the 1991 report from the U.S. Secretary of Labor's Commission on Achieving Necessary Skills (SCANS). Another important aspect of learning and working in the 21st century involves technology skills, and the International Society for Technology in Education, developers of the National Educational Technology Standards (NETS), were strategic partners in the Partnership for 21st Century Skills.

Each postsecondary program of instruction consists of a program description and a suggested sequence of courses that focus on the development of occupational competencies. Each vocational–technical course in this sequence has been written using a common format, which includes the following components:

- Course Name – A common name that will be used by all community/junior colleges in reporting students

- Course Abbreviation – A common abbreviation that will be used by all community/junior colleges in reporting students

- Classification – Courses may be classified as:
    - Vocational–technical core – A required vocational–technical course for all students

  - Area of concentration (AOC) core – A course required in an area of concentration of a cluster of programs
  - Vocational–technical elective – An elective vocational–technical course
  - Related academic course – An academic course that provides academic skills and knowledge directly related to the program area
  - Academic core – An academic course that is required as part of the requirements for an associate's degree

- Description – A short narrative that includes the major purpose(s) of the course and the recommended number of hours of lecture and laboratory activities to be conducted each week during a regular semester

- 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

- Competencies and Suggested Objectives – A listing of the competencies (major concepts and performances) and of the suggested student objectives 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 percent of the time allocated to each course. The remaining 25 percent 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 and revised
  - Activities that implement components of the Mississippi Tech Prep initiative, including integration of academic and vocational–technical skills and coursework, school-to-work transition activities, and articulation of secondary and postsecondary vocational–technical programs
  - Individualized learning activities, including worksite learning activities, to better prepare individuals in the courses for their chosen occupational area

- Sequencing of the course within a program is left to the discretion of the local district. 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 a minimum 15 semester credit hour academic core. Specific courses to be taken within this core are to be determined by the local district. Minimum academic core courses are as follows:
    - 3 semester credit hours — Math/Science Elective
    - 3 semester credit hours — Written Communications Elective
    - 3 semester credit hours — Oral Communications Elective
    - 3 semester credit hours — Humanities/Fine Arts Elective
    - 3 semester credit hours — Social/Behavioral Science Elective

  It is recommended that courses in the academic core be spaced out over the entire length of the program, so that students complete some academic and vocational–technical courses each semester. Each community/junior college has the discretion to select the actual courses that are required to meet this academic core requirement.

- Technical elective courses have been included to allow community colleges and students to customize programs to meet the needs of industries and employers in their area.

In order to provide flexibility within the districts, individual courses within a framework may be customized by:

- adding new competencies and suggested objectives.
- revising or extending the suggested objectives for individual competencies.
- adjusting the semester credit hours of a course to be up one hour or down one hour (after informing the State Board for Community and Junior Colleges [SBCJC] of the change).

In addition, the curriculum framework as a whole may be customized by:

- resequencing courses within the suggested course sequence.
- developing and adding a new course that meets specific needs of industries and other clients in the community or junior college district (with SBCJC approval).
- utilizing the technical elective options in many of the curricula to customize programs.

Table of Contents

Program Description

PROCESS OPERATIONS TECHNOLOGY
PETRO-CHEMICAL EMPHASIS

Process Operations Technology programs prepare technicians for employment in the diverse field of process operations in petroleum refineries, power generation facilities, pharmaceutical plants, chemical plants, waste water treatment plants, food and beverage process plants, offshore oil production facilities and a host of other industries. Individuals currently employed as process operations technicians will enhance their ability to perform their duties and increase opportunities to advance.

This curriculum leads to an Associate of Applied Science degree in Process Operations Technology. Graduates are prepared for entry-level positions at any processing facility. They will have acquired the basic technical skills in equipment and systems and have a broadened vocabulary to make the job-specific learning less difficult. They will also possess team-building skills, safety awareness, environmental awareness, communication skills, and computer skills that are critical in the workplace. They will have a working knowledge of state and federal regulations on safety and the environment. Through an internship program, students have the opportunity to work in a position related to process technology during which they will receive work-related application of their classroom training.

PROGRAM REQUIREMENTS

The standard curriculum for Process Operations Technology is based upon the review of documents, curricula guides, reference guides, state and federal regulations, input from the program advisory committee, and a writing team. The listing of tasks from these sources served as baseline data for the development of this curriculum. The task list used in this curriculum is based upon the following assumptions:

- In all areas, appropriate theory, safety, and support instruction will be provided for each task. It is essential that all instruction include use of appropriate tools, testing, and measuring instruments needed to accomplish certain tasks. It is also assumed that each student has received instruction to locate and use current reference materials from industry publications that present manufacturers' recommended or required specifications and procedures for doing the various tasks.

- The individual program should have written and detailed evaluation standards for each task covered in the curriculum. Learning progress of students should be monitored and evaluated against these stated standards. A system that informs all students of their progress throughout the program should be in place.

- It is recognized that individual courses will differ across the technical programs. The development of appropriate learning activities and tests will be the responsibility of the individual program.

- These standards require that tasks contained in the list be included in the program to validate that the program is meeting the needs of the industry.

The curriculum framework for Process Operations Technology is designed to serve as the core curriculum for approximately 75 percent of each course at the postsecondary level. The remaining 25 percent of each course is to be added at the local level based upon the needs of students and area employers. The technical program in Process Operations Technology requires a minimum of 65 semester credit hours (sch) including 15 semester credit hours of academic core courses and three hours of computer competency.

The curriculum is consistent with the Gulf Coast Process Technology Alliance curriculum requirement of eight core curriculum modules for program endorsement and the program recommendations promulgated by the National Science Foundation and the Center for the Advancement of Process Technology. Graduates from the program will be eligible to take the National Certified Exit Exam for Process Operation Technicians.

Suggested Course Sequence*
Process Operations Technology

FIRST YEAR

3 sch	Written Communications Elective	4 sch	Process Instrumentation I (PPT 1714)
3 sch	Introduction to Process Technology (PPT 1133)	3 sch	Math/Science Elective
3 sch	Computer Applications Elective	4 sch	Process Technology I (Equipment) (PPT 1424)
3 sch	Safety Health, and Environment (PPT 1513)	3 sch	Social/Behavioral Science Elective
3 sch	Technical Elective	4 sch	Process Technology II (Systems) (PPT 1434)
15 sch		18 sch	

SECOND YEAR

4 sch	Process Instrumentation II (PPT 2724)	3 sch	Technical Elective
3 sch	Quality Concepts (PPT 2313)	3 sch	Humanities/Fine Arts Elective
4 sch	Process Technology III (Operations) (PPT 1444)	3 sch	Technical Communications Elective
3 sch	Approved Elective	3 sch	Process Troubleshooting (PPT 2323)
3 sch	Oral Communications Elective	3 sch	Approved Elective
17 sch		15 sch	

* Students who lack entry-level skills in math, English, science, and so forth will be provided related studies.

TECHNICAL ELECTIVES

PPT 2113	Oil and Gas Production I
PPT 2123	Oil and Gas Production II
PPT 1124	Pulping and Bleaching
PPT 1214	Process Chemistry
PPT 2154	Machine Operations for Pulp and Paper Operations
PPT 2234	Power Plant and Chemical Recovery for Pulp and Paper Operations
PPT 1613	Technical Communication
PPT 292(1–6)	Supervised Work Experience in Process Operations Technology
PPT 291(1–3)	Special Project in Process Operations Technology
BOT 2813	Business Communications
CST 1114	Electronics for Computer Servicing

WAN 1413	Communication Hardware
WBL (1–6)	Work-Based Learning [WBL 191(1–3), WBL 192(1–3), WBL 193(1–3), WBL 291(1–3), WBL 292(1–3), and WBL 293(1–3)]

Process Operations Technology Courses

Course Name: Pulping and Bleaching

Course Abbreviation: PPT 1124

Classification: Vocational–Technical Elective

Description: This course provides an introduction to major pulping and bleaching processes and chemistry used. This is a lecture–laboratory class covering the basic types of laboratory techniques used in the pulp and paper industry. The main emphasis is the practical aspects of techniques, procedures, and use of equipment, calibration of equipment, and the interpretation of data. (4 sch: 3-hr lecture, 2-hr lab)

Prerequisite: Process Chemistry (PPT 1214), Introduction to Process Technology (PPT 1133), or Conditional Approval from Administration

Competencies and Suggested Objectives
1. Describe the alkaline pulping process. a. Give the key characteristics of the kraft pulping process. b. Describe the chemical composition of kraft liquors.
2. Compare batch and continuous pulping systems. a. Compare advantages and disadvantages of batch systems. b. Compare advantages and disadvantages of continuous systems. c. Recognize each type of properly identifying and labeling drawings.
3. Describe typical chip and liquor reactions. a. Explain the effect of the physical properties of the wood on digestion. b. List variables that affect pulp properties.
4. List and describe variables affecting kraft cooking. a. Discuss the effects of chip size. b. Discuss the effects of alkali change. c. Discuss the effects of temperature. d. Discuss variables associated with digester operation.
5. Describe the stock washing operation. a. Explain how a typical rotary drum washer operates. b. List variables that affect the stock washing operation.
6. Demonstrate knowledge of the basic principles of bleaching. a. Define bleaching and bleaching sequence. b. Describe the typical equipment associated with a stage. c. List and describe the benefits of common bleaching agents. d. Discuss the process variables associated with bleaching operations. e. List and explain the importance of key optical properties of bleached pulp (whiteness, brightness, and opacity).

7. Discuss the environmental impact of typical pulp mills and bleach plants.
   a. Discuss the importance of soda loss control.
   b. Explain the importance of fiber loss control.
   c. Describe the impact of suspended solids in wastewater.
   d. Describe potential effluent problems associated with various bleaching agents.
   e. Demonstrate knowledge of the basic principles of bleaching.

STANDARDS

Center for the Advancement of Process Technology Standards

Ads	Adsorption
Bat	Batch reaction
Boi	Boiler feed water
Con	Continuous reaction
Coo	Cooling water
Dec	Decanting
Deh	Dehydration
Dra	Use process drawings
EGD	Electrical generation/distribution
Eqp	Equipment monitoring
Ext	Extraction
FHH	Fired heaters/furnaces
Fl	Fuels
Flr	Flare
Haz	Hazard labeling
Hea	Heat exchangers
HMB	Heat or material balances
Ins	Instrument air
ICS	Instrumentation and control systems
Inv	Inventory control
MQ	Maintain quality
Mat	Material sampling
N	Nitrogen
NG	Natural gas
Op	Operating parameters
PPE	Personal protective equipment
Prc	Procedures
Pro	Process variables
Qa	Quality assurance
Rf	Refrigeration
SEO	Safety equipment operations
SHE	Safety, health, and environment
Stc	Steam condensate
Stg	Steam generation/distribution
Sym	Process symbols

Sys	System components
Trb	Troubleshooting
Wat	Water systems
Wst	Waste incineration

Related Academic Standards

R1	Interpret Graphic Information (forms, maps, reference sources)
R2	Words in Context (same and opposite meaning)
R3	Recall Information (details, sequence)
R4	Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5	Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
M1	Addition of Whole Numbers (no regrouping, regrouping)
M2	Subtraction of Whole Numbers (no regrouping, regrouping)
M3	Multiplication of Whole Numbers (no regrouping, regrouping)
M4	Division of Whole Numbers (no remainder, remainder)
M5	Decimals (addition, subtraction, multiplication, division)
M6	Fractions (addition, subtraction, multiplication, division)
M7	Integers (addition, subtraction, multiplication, division)
M8	Percents
M9	Algebraic Operations
A1	Numeration (ordering, place value, scientific notation)
A2	Number Theory (ratio, proportion)
A3	Data Interpretation (graph, table, chart, diagram)
A4	Pre-Algebra and Algebra (equations, inequality)
A5	Measurement (money, time, temperature, length, area, volume)
A6	Geometry (angles, Pythagorean theory)
A7	Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8	Estimation (rounding, estimation)
L1	Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2	Sentence Formation (fragments, run-on, clarity)
L3	Paragraph Development (topic sentence, supporting sentence, sequence)
L4	Capitalization (proper noun, titles)
L5	Punctuation (comma, semicolon)
L6	Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1	Vowel (short, long)
S2	Consonant (variant spelling, silent letter)
S3	Structural Unit (root, suffix)

21st Century Skills

CS1	Global Awareness
CS2	Financial, Economic, and Business Literacy

CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Biermann, C. J. (1999). *Handbook of pulping and papermaking* (2nd ed.). San Diego. CA: Academic Press.

Smook, G. A. (2003). *Handbook for pulp and paper technologists* (3rd ed.). Bellingham, WA: Angus Wilde.

Web Sites

Paper-Machinery. (2006). *Pulp and paper resources and information site*. Retrieved October 23, 2007, from http://www.paperonweb.com/

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SPG Media Limited. (2006). *Pulpandpaper-technology.com*. Retrieved October 23, 2007, from http://www.pulpandpaper-technology.com/

Course Name: Introduction to Process Technology

Course Abbreviation: PPT 1133

Classification: Vocational–Technical Required Course

Description: An introduction to process operations within the process industry. Topics include technician duties, responsibilities, and expectations; plant organizations; the plant process and utility system; and the physical and mental requirements of the process technician. (3 sch: 3-hr lecture)

Prerequisite: None

Competencies and Suggested Objectives
1. Discuss the history and development of various types of process industries. a. Discuss the history and development of the oil and gas industry. b. Discuss the history and development of the chemical industry. c. Discuss the history and development of the mining industry. d. Discuss the history and development of the power generation industry. e. Discuss the history and development of the pulp and paper industry. f. Discuss the history and development of the wastewater treatment industry. g. Discuss the history and development of the food and beverage industry. h. Discuss the history and development of the pharmaceutical industry.
2. Identify and describe the duties, responsibilities, and expectations of a process technician. a. Describe responsibilities of a process technician. b. Describe the physical and mental requirements of a process technician. c. Describe the challenges of working on a team.
3. Explore the concepts of health, safety, environmental, and quality concerns as related to the process industry. a. Discuss safety, health, and environmental issues and concerns related to process technology. b. Discuss quality concepts as applied to process technology.
4. Identify and describe the function of process equipment. a. Describe basic piping and valves used in process technology. b. Describe the basic functions of drums, tanks, and vessels. c. Describe the basic functions of pumps, compressors, and drivers. d. Describe the basic functions of heat exchangers and cooling towers. e. Describe the basic functions of furnaces and boilers.
5. Identify fundamental process systems. a. Describe the components and functions of the distillation system. b. Describe the components and functions of the controls system. c. Describe the components and functions of the utilities system. d. Describe the components and functions of the auxiliary system. e. Read and interpret drawings of the above processes.

6. Investigate the relationship of math, physics, and chemistry to process technology.
   a. Apply basic principles of math to process technology.
   b. Apply basic principles of physics to process technology.
   b. Apply basic principles of chemistry to process technology.

STANDARDS

Center for the Advancement of Process Technology Standards

Boi	Boiler feed water
Coo	Cooling water
Dec	Decanting
Deh	Dehydration
Dra	Use Process Drawings
EGD	Electrical generation/distribution
Eqp	Equipment monitoring
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Haz	Hazard labeling
Hea	Heat exchangers
Ins	Instrument air
MQ	Maintain quality
Mat	Material sampling
N	Nitrogen
NG	Natural gas
PPE	Personal protective equipment
Prc	Procedures
Pro	Process variables
Qa	Quality assurance
SEO	Safety equipment operations
SHE	Safety, health, and environment
Stc	Steam condensate
Stg	Steam generation/distribution
Sym	Process symbols
Sys	System components
Wat	Water systems

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)

R4 Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5 Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
M1 Addition of Whole Numbers (no regrouping, regrouping)
M2 Subtraction of Whole Numbers (no regrouping, regrouping)
M3 Multiplication of Whole Numbers (no regrouping, regrouping)
M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
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21st Century Skills

CS1 Global Awareness
CS2 Financial, Economic, and Business Literacy
CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

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Video

William's Learning/NUS *Operations Training Program*

Web Site

Center for the Advancement of Process Technology. (1999). Introduction to process technology. In *Web-Based Courses*. Retrieved November 29, 2006, from http://www.captech.org/curric/WebCourses.htm

Course Name: Process Chemistry

Course Abbreviation: PPT 1214

Classification: Vocational–Technical Elective

Description: An introduction to general and organic chemistry as applied to the process industry. Includes instruction on matter, energy, atoms, chemical reactions, and chemical bonding (4 sch: 3-hr lecture, 2-hr lab)

Prerequisite: None

Competencies and Suggested Objectives
1. Demonstrate knowledge of general chemistry concepts. a. Identify chemical symbols, compounds, and elements. b. Explore the use of concepts such as atom, proton, neutron, electron, atomic number, atomic weight, and molecules in calculations. c. Interpret and apply chemical formulas and equations. d. Discuss the concepts of acids, bases, and pH. e. Define covalent and ionic bonds. f. Describe the different types of chemical reactions (oxidation–reduction, equilibrium, combustion, sedimentation/precipitation, etc.).
2. Compare various forms of matter and their properties. a. Compare and contrast the physical and chemical properties of the different forms of matter. b. Demonstrate knowledge of metric and English measurement systems and conversions between these systems.
3. Explore the principles of organic chemistry. a. Identify the sources and structure of organic compounds. b. Identify the physical and chemical properties of hydrocarbons.

STANDARDS

Center for the Advancement of Process Technology Standards

Ads	Adsorption
Bat	Batch reaction
Con	Continuous reaction
Dec	Decanting
Deh	Dehydration
Ext	Extraction
Fl	Fuels
HMB	Heat or material balances
Mat	Material sampling
N	Nitrogen
NG	Natural gas

PPE	Personal protective equipment
Prc	Procedures
SEO	Safety equipment operations
SHE	Safety, health, and environment
Stc	Steam condensate

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
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A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS4 Information and Communication Skills

CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Bettelheim, F. A., Brown, W. H., & March, J. (2004). *Introduction to general, organic, and biochemistry* (7th ed.). Cincinnati, OH: Thomson.

Matar, S., & Hatch, L. F. (2001). *Chemistry of petrochemical processes* (2nd ed.). Houston, TX: Gulf Publishing.

Zumdahl, S. S. (2004). *Introductory chemistry: A foundation* (5th ed.). Boston: Houghton Mifflin.

Journal

American Chemical Society. (2006). *Journal of the American Chemical Society*. Retrieved November 28, 2006, from http://pubs.acs.org/journals/jacsat/

Web Site

Scientific Update. (2006). *What's New in Process Chemistry?* Retrieved November 28, 2006, from http://scientificupdate.co.uk/services/newsletter.php

Course Name: Process Technology I (Equipment)

Course Abbreviation: PPT 1424

Classification: Vocational–Technical Core

Description: Instruction in the use of common process equipment including piping, valves, pumps, compressors, drivers, and fixed equipment such as exchangers, tanks, drums, and vessels (4 sch: 3-hr lecture, 2-hr lab)

Prerequisite: None

Competencies and Suggested Objectives
1. Describe various types of piping equipment commonly found in refining and petro-chemical industries. a. Differentiate between pipes, tubing, hoses, and fittings, and explain the use of each. b. Define the role and purpose of valves in the overall operation of the plant.
2. Describe various types of rotating equipment commonly found in refining and petro-chemical industries. a. Describe the importance and application of pumps and compressors in the refining and petro-chemical industries. b. Describe the importance and application of motors and engines in the refining and petro-chemical industries. c. Explain the fundamental purpose and common industrial application of power transmission and lubrication.
3. Describe various types of fixed equipment commonly found in refining and petro-chemical industries. a. Describe the importance and application of heat exchangers in the refining and petro-chemical industries. b. Describe the importance and application of furnaces and boilers in the refining and petro-chemical industries. c. Describe the importance and application of cooling towers in the refining and petro-chemical industries. d. Describe the importance and application of driers, filters, and extruders in the refining and petro-chemical industries. e. Describe the importance and application of vessels in the refining and petro-chemical industries.
4. Use process and piping diagrams and drawings to explain process flows and identify equipment in a unit/system. a. Interpret process and instrumentation diagrams (PIDs). b. Interpret process flow drawings.

STANDARDS

Center for the Advancement of Process Technology Standards

Ads	Adsorption
Bat	Batch reaction
Boi	Boiler feed water
Con	Continuous reaction
Coo	Cooling water
Dec	Decanting
Deh	Dehydration
Dra	Use process drawings
EGD	Electrical generation/distribution
Eqp	Equipment monitoring
Ext	Extraction
FHH	Fired heaters/furnaces
Fl	Fuels
Flr	Flare
Hea	Heat exchangers
HMB	Heat or material balances
Ins	Instrument air
N	Nitrogen
NG	Natural gas
PPE	Personal protective equipment
Rf	Refrigeration
SEO	Safety equipment operations
SHE	Safety, health, and environment
Stc	Steam condensate
Stg	Steam generation/distribution
Sym	Process symbols
Sys	System components
Wat	Water systems
Wst	Waste incineration

Related Academic Standards

R1	Interpret Graphic Information (forms, maps, reference sources)
R2	Words in Context (same and opposite meaning)
R3	Recall Information (details, sequence)
R4	Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5	Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
L1	Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2	Sentence Formation (fragments, run-on, clarity)
L3	Paragraph Development (topic sentence, supporting sentence, sequence)
L4	Capitalization (proper noun, titles)

L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Center for the Advancement of Process Technology. (2000). *Process technology I – Equipment instructor manual.* Webster, TX: Author.

Center for the Advancement of Process Technology. (2000). *Process technology I – Equipment student workbook.* Webster, TX: Author.

Thomas, C. E. (2007). *Process technology: Equipment and systems* (2nd ed.). Clifton Park, NY: Thomson Learning.

Web Site

Center for the Advancement of Process Technology. (2000). Process technology I: Equipment. In *Web-Based Courses*. Retrieved November 29, 2006, from http://www.captech.org/curric/ WebCourses.htm

Course Name: Process Technology II (Systems)

Course Abbreviation: PPT 1434

Classification: Vocational–Technical Core

Description: Study of the interrelation of process equipment and process systems including related scientific principles (4 sch: 3-hr lecture, 2-hr lab)

Pre/Corequisite: Process Technology I (Equipment) (PPT 1424)

Competencies and Suggested Objectives
1. Describe and identify the types of systems used in the process industry. a. Identify the components and functions of the potable water system. b. Identify the components and functions of the fire water system. c. Identify the components and functions of the service/utility water systems. d. Identify the components and functions of the wastewater systems. e. Identify the components and functions of the cooling water systems. f. Identify the components and functions of the relief and flare systems. g. Identify the components and functions of the electrical power generation and distribution systems. h. Identify the components and functions of the material storage systems. i. Identify the components and functions of the blending systems. j. Identify the components and functions of the refrigeration system. k. Identify the components and functions of the steam generation and distribution systems. l. Identify the components and functions of the boiler feed water systems. m. Identify the components and functions of the boiler systems. n. Identify the components and functions of the steam distribution systems. o. Identify the components and functions of the reaction systems. p. Identify the components and functions of the separation systems. q. Identify the components and functions of the extraction systems. r. Identify the components and functions of the distillation systems. s. Identify the components and functions of the stripping systems. t. Identify the components and functions of the absorption systems. u. Identify the components and functions of the dehydration systems. v. Identify the components and functions of the adsorption systems. w. Identify the components and functions of the filtration systems.
2. Describe typical process technician responsibilities for the following: a. Operating systems b. Monitoring systems c. Troubleshooting systems d. Completing rounds e. Communication between inside and outside operators f. Communication between process technician and other departments

3. Describe typical process technician responsibilities for the following:
   a. Implementing established procedures and specifications
   b. Completing maintenance tasks as assigned
   c. Monitoring and maintaining auxiliary equipment
   d. Completing related sampling and analysis tasks and responding appropriately to results
   e. Communicating problems to appropriate personnel
   f. Communicating relevant information to other units
   g. Identifying system problems
   h. Comparing and contrasting control systems used in utility, auxiliary, and process systems
   i. Listing factors that can affect plant economics

STANDARDS

Center for the Advancement of Process Technology Standards

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Bat	Batch reaction
Boi	Boiler feed water
Con	Continuous reaction
Coo	Cooling water
Dec	Decanting
Deh	Dehydration
Dra	Use process drawings
EGD	Electrical generation/distribution
Eqp	Equipment monitoring
Ext	Extraction
FHH	Fired heaters/furnaces
Fl	Fuels
Flr	Flare
Hea	Heat exchangers
Ins	Instrument air
MQ	Maintain quality
Mat	Material sampling
N	Nitrogen
NG	Natural gas
Op	Operating parameters
PPE	Personal protective equipment
Prc	Procedures
Pro	Process variables
Qa	Quality assurance
Rf	Refrigeration
SEO	Safety equipment operations
SHE	Safety, health, and environment
Stc	Steam condensate
Stg	Steam generation/distribution

Sym	Process symbols
Sys	System components
Trb	Troubleshooting
Wat	Water systems
Wst	Waste incineration

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5 Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS1 Global Awareness
CS2 Financial, Economic, and Business Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Center for the Advancement of Process Technology. (2001). *Process technology II: Systems instructor manual.* Webster, TX: Author.

Center for the Advancement of Process Technology. (2001). *Process technology II: Systems student workbook.* Webster, TX: Author.

Speegle, M. (2007). *Process technology systems.* Clifton Park, NY: Thomson Learning.

Thomas, C. E. (2006). *Process technology: Equipment and systems* (2nd ed.). Cincinnati, OH: Thomson.

Computer Software

Simtronics Corp. (2003). *DSS-100 for Windows* (Version 5.4.1) [Computer software]. Little Silver, NJ: Author.

Web Site

Center for the Advancement of Process Technology. (2000) Process technology II: Systems. In *Web-Based Courses*. Retrieved November 29, 2006, from http://www.captech.org/curric/WebCourses.htm

Course Name: Process Technology III (Operations)

Course Abbreviation: PPT 1444

Classification: Vocational–Technical Core

Description: A course that combines equipment systems into operational units with an emphasis on instruction for start-up, normal operation, abnormal/emergency operations, and shutdown of an entire process (4 sch: 3-hr lecture, 2-hr lab)

Prerequisite: None

Competencies and Suggested Objectives
1. Describe and apply procedures for a normal startup. a. Identify components of an operating unit, and trace the process flow through the unit using drawings and diagrams. b. Differentiate between the startup of a new unit and the start-up of an existing unit. c. Discuss and compare different types of start-ups such as normal/routine, start-up after an emergency shutdown, and start-up after maintenance/turnaround. d. Discuss communication methods and procedures used by all personnel during start-up. e. Discuss the use of lockout–tagout and other process safety procedures used in start-up. f. Develop operating procedures and documentation for a given start-up process. g. Describe the purpose and function of utility and auxiliary systems that support the operating unit.
2. Describe and apply procedures for normal operations. a. Describe and compare routine duties performed by a field technician and by a control room technician (surveillance/monitoring; housekeeping; safety, health, and environment; sampling and testing, etc.). b. Read and interpret normal operating procedure manuals and documentation. c. Practice effective verbal and written communication between shift members and other shift members. d. Describe factors involved in on-the-job training within a process unit (organization, demonstration, instruction, observation, feedback, etc.) to simulate an emergency situation and the procedure that should be followed.
3. Describe and apply procedures for abnormal/emergency operations and situations. a. Describe types of abnormal/emergency events that may occur and the actions that should be followed during each event. b. Identify factors to consider in preparing an emergency response that complies with safety, health, and environmental regulations. c. Participate in a tabletop drill.
4. Describe and apply procedures for normal shutdown of a process unit. a. Differentiate between the types of shutdowns (normal, emergency, equipment maintenance, and turnaround). b. Discuss shutdown steps, procedures, and activities for the process system and its auxiliary and utility units. c. Identify safety, health, and environmental risks and hazards involved in preparing

equipment for maintenance, and identify ways to avoid these risks and hazards.
d. Identify information that must be communicated to others during a shutdown, and select the most appropriate method for communication.

STANDARDS

Center for the Advancement of Process Technology Standards

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Coo	Cooling water
Dec	Decanting
Deh	Dehydration
Dra	Use process drawings
EGD	Electrical generation/distribution
Eqp	Equipment monitoring
Ext	Extraction
FHH	Fired heaters/furnaces
Fl	Fuels
Flr	Flare
Haz	Hazard labeling
Hea	Heat exchangers
HMB	Heat or material balances
Ins	Instrument air
ICS	Instrumentation and control systems
Inv	Inventory control
MQ	Maintain quality
Mat	Material sampling
N	Nitrogen
NG	Natural gas
Op	Operating parameters
PPE	Personal protective equipment
Prc	Procedures
Pro	Process variables
Qa	Quality assurance
Rf	Refrigeration
SEO	Safety equipment operations
SHE	Safety, health, and environment
Stc	Steam condensate
Stg	Steam generation/distribution
Sym	Process symbols
Sys	System components
Trb	Troubleshooting
Wat	Water systems

Wst Waste incineration

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5 Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS1 Global Awareness
CS2 Financial, Economic, and Business Literacy
CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Alvin Community College. (2000). *Process technology 3 – Operations*. Alvin, TX: Author.

Center for the Advancement of Process Technology. (2000). *Process technology: Operations instructor manual.* Webster, TX: Author.

Center for the Advancement of Process Technology. (2000). *Process technology: Operations student workbook*. Webster, TX: Author.

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Web Site

Center for the Advancement of Process Technology. (2000) Process technology III: Operations. In *Web-Based Courses*. Retrieved November 29, 2006, from http://www.captech.org/curric/WebCourses.htm.

Course Name: Safety, Health, and Environment

Course Abbreviation: PPT 1513

Classification: Vocational–Technical Core

Description: Development of knowledge and skills to reinforce attitudes and behaviors required for safe and environmentally sound work habits. Emphasis is placed on safety, health, and environmental issues in the performance of all job tasks and regulatory compliance issues. (3 sch: 3-hr lecture)

Prerequisite: None

Competencies and Suggested Objectives
1. Identify and describe common types of hazards in process technology. a. Describe hazards related to chemical agents. b. Describe hazards related to noise, heat, radiation, and electricity. c. Describe hazards related to fire, explosion, and detonation. d. Describe hazards related to biological and ergonomic factors.
2. Identify and describe government regulations and agencies that regulate worker and environmental safety. a. Identify the role that the Occupational Safety and Health Administration (OSHA) plays in regulating and promoting worker safety in industry. b. Identify the role that the Environmental Protection Agency (EPA) and state agencies play in regulating and promoting environmental safety. c. Identify the role that other state, federal, and private regulatory agencies play in regulating and promoting safety.
3. Describe policies, procedures, and controls that are designed to ensure and promote worker safety. a. Identify engineering controls including alarms, indications, process containment, and process upset controls. b. Identify administrative controls, including programs and practices. c. Identify personal protective equipment (PPE). d. Identify monitoring and sensing equipment. e. Describe the use of permitting systems to protect workers and the environment. f. Describe the use of fire, rescue, and emergency equipment in industry.

STANDARDS

Center for the Advancement of Process Technology Standards

Dra	Use process drawings
EGD	Electrical generation/distribution
Eqp	Equipment monitoring
FHH	Fired heaters/furnaces
Fl	Fuels

Flr	Flare
Haz	Hazard labeling
Hea	Heat exchangers
MQ	Maintain quality
Mat	Material sampling
N	Nitrogen
NG	Natural gas
Op	Operating parameters
PPE	Personal protective equipment
Prc	Procedures
Pro	Process variables
SEO	Safety equipment operations
SHE	Safety, health, and environment
Stc	Steam condensate
Sym	Process symbols
Trb	Troubleshooting

Related Academic Standards

R1	Interpret Graphic Information (forms, maps, reference sources)
R2	Words in Context (same and opposite meaning)
R3	Recall Information (details, sequence)
R4	Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5	Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
L1	Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2	Sentence Formation (fragments, run-on, clarity)
L3	Paragraph Development (topic sentence, supporting sentence, sequence)
L4	Capitalization (proper noun, titles)
L5	Punctuation (comma, semicolon)
L6	Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1	Vowel (short, long)
S2	Consonant (variant spelling, silent letter)
S3	Structural Unit (root, suffix)

21st Century Skills

CS1	Global Awareness
CS3	Civic Literacy
CS4	Information and Communication Skills
CS5	Thinking and Problem-Solving Skills
CS6	Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Center for the Advancement of Process Technology. (1999). *Safety, health and environment student workbook*. Webster, TX: Author.

Center for the Advancement of Process Technology. (1999). *Safety, health and environment, volumes I and II*. Webster, TX: Author.

Center for the Advancement of Process Technology. (2006). *Safety, health and the environment.* Upper Saddle River, NJ: Pearson.

Speegle, M. (2005). *Safety, health, and environmental concepts for the process industry*. Berne, NY: Uhai.

VanCise, D., & VanCise, M. (2004). *Construction industry guide to OSHA*. Florence, KY: Thomson.

Web Site

Center for the Advancement of Process Technology. (2000). Safety, health, and environment. In *Web-Based Courses*. Retrieved November 29, 2006, from http://www.captech.org/curric/WebCourses.htm

Course Name: Technical Communication

Course Abbreviation: PPT 1613

Classification: Vocational–Technical Elective

Description: An application of written, oral, and other forms of communication to the process technology industry. Includes instruction and practice in written communications (reports and presentations, procedures, resumes, documentation, training materials, etc.) and oral communications (presentations, directions/instructions, feedback, etc.) (3 sch: 3-hr lecture)

Prerequisite: None

Competencies and Suggested Objectives
1. Organize and compose effective written communications. a. Identify direct, indirect, and persuasive approaches to writing. b. Develop skills to produce clear, concise, complete, accurate, and courteous messages. c. Compose effective correspondence (e-mail, memos, and letters). d. Compose a technical report illustrating proper organization and effective use of data tables, charts, and graphs. e. Compose written procedures and documentation for process technology operations.
2. Organize and compose effective oral communications. a. Compose and deliver oral instructions and reports. b. Receive and interpret oral instructions and directions. c. Develop and present an oral demonstration using graphics, tables, and equipment. d. Give and receive positive feedback from other individuals. e. Apply skills for oral interviews.
3. Prepare written communications involved in the job application process. a. Complete an application form. b. Complete a resume. c. Update a resume. d. Compose letters of application, follow-up, acceptance, and resignation.

STANDARDS

Center for the Advancement of Process Technology Standards

Dra	Use process drawings
Eqp	Equipment monitoring
Haz	Hazard labeling
Inv	Inventory control
MQ	Maintain quality
Mat	Material sampling
Prc	Procedures
Pro	Process variables
Qa	Quality assurance

SEO	Safety equipment operations
SHE	Safety, health, and environment
Sym	Process symbols
Sys	System components
Trb	Troubleshooting

Related Academic Standards

R1	Interpret Graphic Information (forms, maps, reference sources)
R2	Words in Context (same and opposite meaning)
R3	Recall Information (details, sequence)
R4	Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5	Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
A3	Data Interpretation (graph, table, chart, diagram)
L1	Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2	Sentence Formation (fragments, run-on, clarity)
L3	Paragraph Development (topic sentence, supporting sentence, sequence)
L4	Capitalization (proper noun, titles)
L5	Punctuation (comma, semicolon)
L6	Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1	Vowel (short, long)
S2	Consonant (variant spelling, silent letter)
S3	Structural Unit (root, suffix)

21st Century Skills

CS1	Global Awareness
CS2	Financial, Economic, and Business Literacy
CS3	Civic Literacy
CS4	Information and Communication Skills
CS5	Thinking and Problem-Solving Skills
CS6	Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Polking, K. (1982). *Effective written communication for supervisors*. Barrington, IL: TPC Training Systems.

Reece, B., & Brandt, R. (2005). *Effective human relations: Personal and organizational applications.* Boston, MA: Houghton Mifflin.

Course Name: Process Instrumentation I

Course Abbreviation: PPT 1714

Classification: Vocational–Technical Core

Description: A study of the instruments and instrument systems used in chemical processing industry including terminology, primary variables, symbols, and control loops (4 sch: 3-hr lecture, 2-hr lab)

Prerequisite: None

Competencies and Suggested Objectives
1. Describe and apply the major elements of process technology. a. Define pressure, and apply related measurements and processes used in the process industry. b. Define temperature, and apply related measurements and processes used in the process industry c. Define level, and apply related measurements and processes used in the process industry. d. Define flow, and apply related measurements and processes used in the process industry. e. Define analytical instrumentation, and apply related measurements and processes used in the process industry.
2. Describe and explain the functions and components of process control. a. Identify and describe the various pieces of equipment used in instrumentation (transmitters; transducers; differential pressure cells; analog, pneumatic, and digital instruments; etc.) b. Describe valves used in instrumentation (globe, three-way, butterfly, etc.). c. Explain the functions and components of a control loop, and contrast the differences between open and closed controls. d. Describe the relationship between measurement instruments and their role in the overall control loop process.
3. Describe and interpret the types of process industry drawings. a. Compare and contrast piping and instrument diagrams (P&IDs) and process flow drawings (PFDs). b. Describe the lettering and numbering standards based on ISA instrumentation symbols. c. Describe how to determine the instrument type from the symbol information. d. Describe the standards for line symbols.
4. Describe the role and function of advanced controls and controllers in process operations. a. Identify the different advanced controls and controllers and their primary function.

STANDARDS

Center for the Advancement of Process Technology Standards

Dra	Use process drawings
EGD	Electrical generation/distribution
Eqp	Equipment monitoring
FHH	Fired heaters/furnaces
HMB	Heat or material balances
Ins	Instrument air
ICS	Instrumentation and control systems
MQ	Maintain quality
N	Nitrogen
Op	Operating parameters
PPE	Personal protective equipment
Prc	Procedures
Pro	Process variables
Qa	Quality assurance
SEO	Safety equipment operations
SHE	Safety, health, and environment
Sym	Process symbols
Sys	System components
Trb	Troubleshooting

Related Academic Standards

R1	Interpret Graphic Information (forms, maps, reference sources)
R2	Words in Context (same and opposite meaning)
R3	Recall Information (details, sequence)
R4	Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5	Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
M1	Addition of Whole Numbers (no regrouping, regrouping)
M2	Subtraction of Whole Numbers (no regrouping, regrouping)
M3	Multiplication of Whole Numbers (no regrouping, regrouping)
M4	Division of Whole Numbers (no remainder, remainder)
M5	Decimals (addition, subtraction, multiplication, division)
M6	Fractions (addition, subtraction, multiplication, division)
M7	Integers (addition, subtraction, multiplication, division)
M8	Percents
M9	Algebraic Operations
A1	Numeration (ordering, place value, scientific notation)
A2	Number Theory (ratio, proportion)
A3	Data Interpretation (graph, table, chart, diagram)
A4	Pre-Algebra and Algebra (equations, inequality)
A5	Measurement (money, time, temperature, length, area, volume)

A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Center for the Advancement of Process Technology. (2002). *Instrumentation instructor manual, volumes I and II.* Webster, TX: Author.

Center for the Advancement of Process Technology. (2005). *Process technology instrumentation*. Upper Saddle River, NJ: Pearson Custom.

Simons, S. (2002). *Process plant instrumentation*. Berne, NY: Uhai.

Simons, S. (2004). *Technician's guide to instrumentation*. Berne, NY: Uhai.

Web Site

Center for the Advancement of Process Technology. (2002). Instrumentation. In *Web-Based Courses*. Retrieved November 29, 2006, from http://www.captech.org/curric/WebCourses.htm

Course Name: Oil and Gas Production I

Course Abbreviation: PPT 2113

Classification: Vocational–Technical Elective

Description: An overview of the petroleum industry including exploration and geology, well drilling, wellhead operations, and product distribution. Emphasis is placed on oil and gas production. (3 sch: 3-hr lecture)

Prerequisite: None

Competencies and Suggested Objectives
1. Describe the process of oil exploration and associated geological principles. a. Discuss the basic concepts of geology related to oil and gas exploration and production (reservoirs, fluid flow, and pressure). b. Discuss the basic concepts of oil and gas exploration including geographic and geophysical surveys, data sources, reservoir development tools, resource ownership, and so forth.
2. Describe the oil and gas drilling process and wellhead development procedures. a. Identify and describe the procedures and equipment used in well construction. b. Identify and describe the procedures and equipment used in well completion. c. Identify and describe the procedures and equipment used in well workover and servicing.
3. Describe wellhead operations and production. a. Identify and describe the functions of the major components of a wellhead. b. Compare and contrast the differences in wellhead construction for onshore and offshore facilities. c. Identify and discuss safety, health, and environmental factors associated with wellhead production. d. Describe the activities associated with monitoring and regulating the wellhead, including typical malfunctions, and maintenance activities. e. Simulate the operation, shut-in, and start-up of a well.
4. Describe the separation and treatment of emulsions. a. Describe the process and equipment used to separate the emulsion and the products obtained from the separation. b. Discuss the processes, materials, and equipment used to treat the emulsion and dispose of waste products. c. Describe activities associated with maintaining emulsion separation systems. d. Compare and contrast emulsion separation and treatment processes in onshore and offshore facilities. e. Simulate the operation and troubleshooting of an emulsion separation and treatment system.

STANDARDS

Center for the Advancement of Process Technology Standards

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Coo	Cooling water
Dec	Decanting
Deh	Dehydration
Dra	Use process drawings
EGD	Electrical generation/distribution
Eqp	Equipment monitoring
Ext	Extraction
FHH	Fired heaters/furnaces
Fl	Fuels
Flr	Flare
Haz	Hazard labeling
Hea	Heat exchangers
HMB	Heat or material balances
Ins	Instrument air
ICS	Instrumentation and control systems
Inv	Inventory control
MQ	Maintain quality
Mat	Material sampling
N	Nitrogen
NG	Natural gas
Op	Operating parameters
PPE	Personal protective equipment
Prc	Procedures
Pro	Process variables
Qa	Quality assurance
Rf	Refrigeration
SEO	Safety equipment operations
SHE	Safety, health, and environment
Stc	Steam condensate
Stg	Steam generation/distribution
Sym	Process symbols
Sys	System components
Trb	Troubleshooting
Wat	Water systems
Wst	Waste incineration

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R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5 Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
M1 Addition of Whole Numbers (no regrouping, regrouping)
M2 Subtraction of Whole Numbers (no regrouping, regrouping)
M3 Multiplication of Whole Numbers (no regrouping, regrouping)
M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS1 Global Awareness
CS2 Financial, Economic, and Business Literacy
CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

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Course Name: Oil and Gas Production II

Course Abbreviation: PPT 2123

Classification: Vocational–Technical Elective

Description: A continuation of Oil and Gas Production I with emphasis on oil and natural gas production and processing (3 sch: 3-hr lecture)

Prerequisite: Oil and Gas Production I (PPT 2113)

Competencies and Suggested Objectives
1. Discuss the processes of gas treatment, dehydration, and compression. a. Discuss the composition and physical properties of natural gas. b. Describe treatments of natural gas including separation, dehydration, and conditioning. c. Compare and contrast liquid and solid dehydration processes, including equipment and procedures. d. Describe the process, equipment, and procedures used in natural gas compression.
2. Describe the processes, equipment, and procedures used in produced water treatment and handling. a. Describe techniques used to treat and/or dispose of produced water in an onshore and offshore facility. b. Identify and describe the functions of major components of the produced water treatment system. c. Describe activities associated with monitoring and maintaining produced water treatment systems. d. Describe safety, health, and environmental concerns associated with working with the produced water treatment process.
3. Describe the purpose and operation of auxiliary systems. a. Discuss how auxiliary systems support a production facility, including instrument air systems, flare and relief systems, fuel gas systems, electrical distribution systems, and so forth. b. Discuss pigging operations including different types of pigs, launching and recovery, and safety. c. Discuss the process technician's role in operation and maintenance of auxiliary systems.
4. Describe the purpose and operation of artificial lift and enhanced recovery techniques. a. Explain the different artificial methods available for lifting hydrocarbons. b. Describe the equipment used for each type of lift. c. Describe processes and equipment involved in different artificial and enhanced recovery processes including beam pumping, subsurface hydraulic pumping, electric submersible pumping, water flooding, and so forth.
5. Describe the purpose and operation of pumping and transportation systems used in oil and gas production. a. Identify methods used to transport oil and gas products, including barges, railway, motor transportation, pipelines, and so forth.

b. Discuss pipeline construction procedures for onshore and offshore operations. c. Discuss economic and safety issues associated with the transportation of oil and gas products.
6. Identify and describe safety, health, and environmental considerations associated with oil and gas production. a. Discuss governmental agencies and regulations associated with oil and gas production, including Coast Guard, Minerals Management Service, American Petroleum Institute, Department of Transportation, OSHA, and EPA. b. Discuss safety issues related to oil and gas production including rigging and hoisting, helicopter and boat safety, and hazardous and nonhazardous waste disposal.
7. Discuss refining and processing operations. a. Outline the process and products from refining. b. Outline the processes and products from natural gas production. c. Identify major petrochemicals that can be derived from petroleum. d. Explain the relationship of efficient oil and gas production to efficient crude oil refining, natural gas processing, and petrochemical processing.

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Videos

A&E Television Networks. (2005). *Black gold* [DVD]. New York, NY: Author.

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Petroleum Extension Service. (1998). *Producing oil* [Videotape]. Austin, TX: Author.

Web Site

Astron International. (2006). Technical support service. In *Refining Online*. Retrieved December 2, 2006, from http://www.refiningonline.com/

Course Name: Machine Operations for Pulp and Paper Operations

Course Abbreviation: PPT 2154

Classification: Vocational–Technical Elective

Description: This course concentrates on the functions and capability of all critical equipment in the paper mill including stock preparation, approach flow, fourdrinier, press section, drier section, calendaring, winding, and finishing operations. Primary process flows, consistency control, stock blending, stock refining, wet end chemistry, stock cleaning, approach flow systems, and the cause and effect relationships each of these has with the various papermaking parameters are discussed. Components of the machine fourdrinier and the concepts of formation, retention, drainage, and pressing are also explored. (4 sch: 3-hr lecture, 2-hr lab)

Prerequisite: Process Chemistry (PPT 1214) and Introduction to Process Technology (PPT 1133)

Competencies and Suggested Objectives
1. Explain what is meant by the term "furnish." a. List and give properties of common virgin papermaking fibers. b. Explain the importance of water in the papermaking process. c. Name some common additives used in papermaking. d. Discuss the handling system and use of broke and other secondary fibers.
2. Trace the flow of stock through a typical stock prep system (from high-density storage to the headbox). a. Compare the goals of screening and cleaning. b. Discuss the importance of refining, and compare the effects achieved with disc and conical refiners. c. Discuss the importance of consistency control in stock prep operations, and describe how this is accomplished.
3. Discuss the use of additives commonly used in papermaking. a. Compare various sizing agents, and explain why sizing is important. b. Discuss the use of wet and dry strength additives. c. Describe common dyes used for coloring paper. d. Explain why biocides and slimicides might be used. e. Discuss the use of retention aids.
4. Describe the forming process utilized on a typical fourdrinier machine. a. Describe the elements of a typical approach flow system. b. Compare and contrast various headbox designs. c. List common table elements, and describe their purpose. d. Explain how white water and broke are typically handled and recycled at the wet end. e. Discuss the importance of pressing, and compare various press designs.
5. Describe the steam and condensate system and the pocket ventilation system in paper machine drier sections. a. Use drawings to illustrate the behavior of condensate in a drier cylinder. b. Label the components of a siphon assembly and rotary pressure steam joint on a

drawing of a drier can. c. Label the components of a two-tier cylinder drying configuration. d. Explain the cascade system for utilization of blow through steam.
6. Explain the importance of calendering and profile controlling. a. List advantages and disadvantages of both on-machine and off-machine calendering. b. Describe the configuration of a super calender, and explain its advantages. c. Discuss what is meant by the term “profile control,” and describe various sensors used for this purpose.
7. Perform quality tests on finished paper products with various end uses. a. Describe common sheet defects. b. Explain how surface quality relates to print quality. c. Distinguish among various methods of printing.
8. Demonstrate an understanding of common converting operations. a. Discuss the principles of winding, and compare various types of winding equipment. b. Describe methods of controlling sheets defects. c. Explain proper procedures for roll wrapping and handling, and list the features of a quality wrapped roll. d. Describe the fundamentals of sheeting and handling cut sized paper.

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L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS1 Global Awareness
CS2 Financial, Economic, and Business Literacy
CS3 Civic Literacy
CS4 Information and Communication Skills
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CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

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Smook, G. A. (2003). *Handbook for pulp and paper technologists* (3rd ed.). Bellingham, WA: Angus Wilde.

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SPG Media Limited. (2006). *Pulpandpaper-technology.com*. Retrieved October 23, 2007, from http://www.pulpandpaper-technology.com/

Course Name: Power Plant and Chemical Recovery for Pulp and Paper Operations

Course Abbreviation: PPT 2234

Classification: Vocational–Technical Elective

Description: The purpose of this course is to present fundamental principles of boiler operation for both power boilers and chemical recovery boilers. Emphasis is on the basic requirements for steam production and chemical recovery. Topics explored include the basic design of water tube and fire tube boilers, the concept of heat transfer, the concepts of natural and forced circulation, air and fuel supply systems, condensate and feedwater systems, the concept of chemical recovery, evaporation and deposition, and plugging problems. (4 sch: 3-hr lecture, 2-hr lab)

Prerequisite: None

Competencies and Suggested Objectives
1. Differentiate among various boiler designs, and identify key components of each type. a. Illustrate the basic design of chemical recovery boilers and waste fuel boilers. b. Describe the construction of a typical power boiler. c. Name the major related boiler systems, and explain the role that each of these play in boiler operation.
2. Demonstrate knowledge of the chemical recovery process in a kraft mill. a. Explain the steps involved in the conversion of white liquor to black liquor, black liquor to green liquor, and green liquor to white liquor. b. Describe the operation of multiple-effect evaporators. c. Discuss factors that affect evaporator and recovery boiler operation. d. Discuss process variables that are important to the causticizing operation.
3. Describe the water treatment systems vital to power plant operations. a. Differentiate between influent and effluent water systems in terms of the sources for each, common contaminants in each, and typical treatments applied to each type. b. Explain how a water treatment clarifier operates. c. Explain the importance of demineralization and deaeration in water treatment, and describe the operation of typical equipment used in each process. d. Discuss the importance of water quality to pulp and paper operations, and discuss its potential impact on the environment.

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M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
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L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
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L3 Paragraph Development (topic sentence, supporting sentence, sequence)
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L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

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Course Name: Quality Concepts

Course Abbreviation: PPT 2313

Classification: Vocational–Technical Core

Description: A course to provide an introduction to the field of quality in the process industry. Students are introduced to industry-related process concepts including operating consistency, continuous improvement, plant economics, team skills, and statistical process control (SPC). (3 sch: 3-hr lecture)

Prerequisite: None

Competencies and Suggested Objectives
1. Describe the relationship between plant economics and total quality management (TQM). a. Discuss the philosophy, methods, and elements of TQM, contrasting these factors with previous quality philosophies. b. Identify and discuss the relationship between economic factors affecting plant production including competition, supply and demand, inflation, risk, productivity, standard of living, and downsizing. c. Discuss and apply basic accounting principles including revenue, profit and loss, income, assets and liabilities, fixed and variable costs, depreciation, taxes, and so forth. d. Discuss the impact of productivity, lost opportunities, and substandard work.
2. Discuss the relationship between customer relationships and productivity/profit. a. Identify and distinguish among the different types of customers (internal and external). b. Discuss the basic principles of customer service including customer specifications and requirements, customer processes, customer visits, and so forth. c. Evaluate and improve personal strengths and weaknesses including time management, organization, planning and prioritizing skills, and personal qualities such as patience, initiative, flexibility, adaptability, confidence, efficiency, and work ethic. d. Recognize the importance of alignment of personal values with those of the organization. e. Explain the concept of lifelong learning as applied to process technology.
3. Apply effective communication and team skills. a. Describe and demonstrate effective verbal and written communication skills and techniques including use of plant jargon and terminology, body language, and common communication methods. b. Discuss basic principles of teams and teamwork including life cycle, team dynamics, diversity, respect and courtesy, meeting management techniques, interpersonal skills, personality types, and so forth.
4. Describe concepts related to processes, systems, and organizational learning. a. Compare and contrast processes and systems to include concepts of process orientation, management, and performance. b. Describe systems theory to include interdependency of units and suboptimization. c. Define a “learning organization,” and identify attributes, barriers, and advantages of this organization.

5. Discuss and apply principles of variance and operating consistency.
   a. Define variation, and identify the variables that affect processes.
   b. Discuss the concept of operating consistency and the need for documentation.
   c. Identify the different levels of documentation needed for consistency.
   d. Practice procedures that promote operating consistency including following policies and procedures, taking directions, completing steps in sequential order, and paying attention to detail.
   e. Define continuous improvement, and identify strategies that organizations use to improve their processes.
   f. Define non-conformance, and describe the consequences of not addressing non-conformance.
   g. Discuss various processes used for problem solving and decision making.
6. Describe, apply, and interpret basic statistics and statistical process control procedures.
   a. Define common statistical terms including population, sample, mean, mode, median, location, spread, range, and standard deviation.
   b. Explain the procedures for collecting and using of data.
   c. Identify and describe the use of charts for data representation, analysis, and interpretation.
   d. Apply data collection, representation, analysis, and interpretation in a real-world process industry scenario.

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Speegle, M., & Shah, G. C. (2004). *Quality concepts for the process industry*. Boston, MA: Thomson.

Course Name: Process Troubleshooting

Course Abbreviation: PPT 2323

Classification: Vocational–Technical Core

Description: A course to apply knowledge of process variables, indicators and controllers, troubleshooting tools, and troubleshooting steps to solve problems in a simple process system (3 sch: 3-hr lecture)

Prerequisite: Introduction to Process Technology (PPT 1133) and Process Instrumentation I (PPT 1714)

Competencies and Suggested Objectives
1. Identify and describe the methods and tools of troubleshooting process systems. a. Identify and define the process variables to include naming an example of each variable, identifying the relationships between variables, and explain the meaning of the measured value of each variable. b. Identify and describe the function of instruments in operating and controlling a chemical process including indicators and controllers. c. Identify and define the troubleshooting tools and explain their use. d. Identify and define the troubleshooting steps and explain their use. e. Identify, verify, and analyze data on a process to draw conclusions and answer questions about the status of the process and the cause or causes.
2. Apply the troubleshooting steps and tools to solve simulated problems. a. Troubleshoot simple separation systems. b. Troubleshoot reaction systems. c. Troubleshoot steam generation systems. d. Troubleshoot distillation systems. e. Troubleshoot absorption and stripping systems.

STANDARDS

Center for the Advancement of Process Technology Standards

Ads	Adsorption
Bat	Batch reaction
Boi	Boiler feed water
Con	Continuous reaction
Coo	Cooling water
Dec	Decanting
Deh	Dehydration
Dra	Use process drawings
EGD	Electrical generation/distribution
Eqp	Equipment monitoring
FHH	Fired heaters/furnaces

Fl	Fuels
Flr	Flare
Hea	Heat exchangers
HMB	Heat or material balances
Ins	Instrument air
ICS	Instrumentation and control systems
MQ	Maintain quality
Mat	Material sampling
Op	Operating parameters
PPE	Personal protective equipment
Prc	Procedures
Pro	Process variables
Qa	Quality assurance
SEO	Safety equipment operations
SHE	Safety, health, and environment
Stg	Steam generation/distribution
Sym	Process symbols
Sys	System components
Trb	Troubleshooting

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5 Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Book

Kukuk, M. (1999). *Troubleshooting for process technicians*. Lago Vista, TX: Troubleshooting Resources.

Computer Software

Simtronics Corp. (2003). *DSS-100 for Windows* (Version 5.4.1) [Computer software]. Little Silver, NJ: Author.

Course Name: Process Instrumentation II

Course Abbreviation: PPT 2724

Classification: Vocational–Technical Core

Description: A continuation of the study of varied instruments and instrument systems used in the processing industry, including terminology, primary variables, symbols, control loops, and troubleshooting (4 sch: 3-hr lecture, 2-hr lab)

Prerequisite: Process Instrumentation I (PPT 1714)

Competencies and Suggested Objectives
1. Discuss the types of instruments used in industry to monitor and control processes. a. Review the use of indicators, transmitters/transducers, controllers, final control elements, and control loops. b. Define functions and uses of regulators, switches, relays, and enunciators. c. Discuss signal transmissions and conversions.
2. Discuss the function and use of control schemes in industry. a. Define terms used in controllers and tuning. b. Explain the importance of monitoring controllers. c. Explain the different types of control schemes (on–off, lead–lag, feedback–feedforward). d. Explain the modes of control operation (local, auto, remote).
3. Discuss the various advanced control schemes. a. Discuss terms associated with master–slave, cascade, remote, ratio, split–range, and so forth. b. Explain the purpose of digital control. c. Define terms associated with programmable logic control. d. Explain the purpose of distributed control systems.
4. Explore the use of instrument power supply. a. Define terms associated with instrument power supply. b. Explain the purpose of uninterruptible power supply (UPS).
5. Explore emergency shutdowns, interlocks, and protection devices. a. Describe common types of alarms. b. Discuss emergency shutdown logic (ESD). c. Explain test and reset methods.
6. Explain the different practices related to process technicians' troubleshooting process instruments. a. Explain the importance of process knowledge in troubleshooting. b. Identify typical malfunctions found in primary sensing elements and transmitters. c. Explain the methods used for determining if a sensing/measuring device is malfunctioning. d. Explain the importance of communication between the board technician and the outside process technician when troubleshooting a control loop problem. e. Explain the proper use of hand tools related to process troubleshooting.

f. Discuss safety and environmental issues related to troubleshooting process instruments.

STANDARDS

Center for the Advancement of Process Technology Standards

Dra	Use process drawings
Eqp	Equipment monitoring
HMB	Heat or material balances
Ins	Instrument air
ICS	Instrumentation and control systems
Inv	Inventory control
MQ	Maintain quality
Op	Operating parameters
PPE	Personal protective equipment
Prc	Procedures
Pro	Process variables
Qa	Quality assurance
SEO	Safety equipment operations
SHE	Safety, health, and environment
Sym	Process symbols
Sys	System components
Trb	Troubleshooting

Related Academic Standards

R1	Interpret Graphic Information (forms, maps, reference sources)
R2	Words in Context (same and opposite meaning)
R3	Recall Information (details, sequence)
R4	Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5	Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
M1	Addition of Whole Numbers (no regrouping, regrouping)
M2	Subtraction of Whole Numbers (no regrouping, regrouping)
M3	Multiplication of Whole Numbers (no regrouping, regrouping)
M4	Division of Whole Numbers (no remainder, remainder)
M5	Decimals (addition, subtraction, multiplication, division)
M6	Fractions (addition, subtraction, multiplication, division)
M7	Integers (addition, subtraction, multiplication, division)
M8	Percents
M9	Algebraic Operations
A1	Numeration (ordering, place value, scientific notation)
A2	Number Theory (ratio, proportion)
A3	Data Interpretation (graph, table, chart, diagram)
A4	Pre-Algebra and Algebra (equations, inequality)
A5	Measurement (money, time, temperature, length, area, volume)

A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Center for the Advancement of Process Technology. (2002). *Instrumentation instructor manual, volumes I and II*. Webster, TX: Author.

Center for the Advancement of Process Technology. (2005). *Process technology instrumentation*. Upper Saddle River, NJ: Pearson Custom.

Simons, S. (2002). *Process plant instrumentation*. Florence, KY: Thomson.

Simons, S. (2004). *Technician's guide to instrumentation*. Florence, KY: Thomson.

Web Site

Center for the Advancement of Process Technology. (2002). Instrumentation. In *Web-Based Courses*. Retrieved November 29, 2006, from http://www.captech.org/curric/WebCourses.htm

Course Name: Special Project in Process Operations Technology

Course Abbreviation: PPT 291(1–3)

Classification: Vocational–Technical Elective

Description: A course designed to provide the student with practical application of skills and knowledge gained in other vocational–technical courses. The instructor works closely with the student to ensure that the selection of a project will enhance the student's learning experience. (1–3 sch: 2- to 6-hr lab)

Prerequisite: Consent of the Instructor

Competencies and Suggested Objectives
1. Apply technical skills needed to be a viable member of the workforce. a. Prepare a description of technical skills to be developed in the supervised work experience. b. Develop technical skills needed to be a viable member of the workforce.
2. Apply skills developed in other program area courses. a. Perform skills developed in other program area courses.
3. Apply human relationship skills. a. Use proactive human relationship skills in the supervised work experience.
4. Apply and practice positive work habits and responsibilities. a. Perform assignments to develop work habits and responsibilities.
5. Work with the instructor and employer to develop written occupational objectives to be accomplished. a. Perform written occupational objectives in the supervised work experience.
6. Assess accomplishment of objectives. a. Prepare daily written assessment of accomplishment of objectives. b. Present weekly written reports of activities performed and objectives accomplished to the instructor.
7. Utilize a set of written guidelines for the supervised work experience. a. Develop and follow a set of written guidelines for the supervised work experience.

STANDARDS

Specific standards for this course will depend upon the nature of the problem under investigation.

SUGGESTED REFERENCES

Specific references for use in this course will depend upon the nature of the problem under investigation.

Course Name: Supervised Work Experience in Process Operations Technology

Course Abbreviation: PPT 292(1–6)

Classification: Vocational–Technical Elective

Description: A course that is a cooperative program between industry and education designed to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of one semester hour per 45 industrial contact hours. (1–6 sch: 3- to 18-hr externship)

Prerequisite: Consent of the Instructor

Competencies and Suggested Objectives
1. Prepare a written agreement. a. Compile a written training agreement in cooperation with the instructor and student that details a work schedule and specific tasks/skills to be mastered in the program.
2. Prepare a written report of activities. a. Compile a daily log of activities and tasks. b. Submit weekly reports to the instructor summarizing activities and tasks completed. c. Submit a final report of activities and experiences.
3. Follow written guidelines for work experience programs. a. Complete all required activities in the training agreement. b. Adhere to all written and oral instructions for the supervised experience.

STANDARDS

Specific standards for this course will depend upon the nature of the problem under investigation.

SUGGESTED REFERENCES

Specific references for use in this course will depend upon the nature of the problem under investigation.

Course Name: Work-Based Learning I, II, III, IV, V, and VI

Course Abbreviation: WBL 191(1–3), WBL 192(1–3), WBL 193(1–3), WBL 291(1–3), WBL 292(1–3), and WBL 293(1–3)

Classification: Free Elective

Description: A structured worksite learning experience in which the student, program area teacher, Work-Based Learning Coordinator, and worksite supervisor/mentor develop and implement an educational training agreement. Designed to integrate the student's academic and technical skills into a work environment. May include regular meetings and seminars with school personnel and employers for supplemental instruction and progress reviews (1–3 sch: 3- to 9-hr externship)

Prerequisite: Concurrent enrollment in vocational–technical program area courses

Competencies and Suggested Objectives
1. Apply technical skills and related academic knowledge needed to be a viable member of the workforce. a. Demonstrate technical skills necessary to complete job requirements. b. Demonstrate academic skills necessary to complete job requirements. c. Perform tasks detailed in an educational training agreement at the work setting.
2. Apply general workplace skills to include positive work habits necessary for successful employment. a. Demonstrate appropriate human relationship skills in the work setting to include conflict resolution, team participation, leadership, negotiation, and customer/client service. b. Utilize time, materials, and resource management skills. c. Use critical thinking skills such as problem solving, decision making, and reasoning. d. Acquire, evaluate, organize, maintain, interpret, and communicate information.

STANDARDS

Specific standards for this course will depend upon the nature of the problem under investigation.

SUGGESTED REFERENCES

Specific references for this course will depend upon the nature of the problem under investigation.

Recommended Tools and Equipment

CAPITALIZED ITEMS

1. Acrylic cooling tower—Actual working model (1 per program)
2. Distillation training tower (1 per program)
3. Pump demonstrator—working model (1 per program)
4. Distillation Training Unit (table size) (1 per program)
5. Chiller unit for distillation training unit (table size) (1 per program)
6. Static kettle reboiler and shell and tube reboiler (1 per program)
7. Static Vertical Thermosiphon Reboiler (1 per program)
8. Acrylic boiler—Actual working model (1 per program)
9. Crude oil desalter (1 per program)
10. FCCU (fluid catalytic cracker unit)—Working model (1 per program)
11. DTU-1 Working glass distillation training unit (1 per program)
12. Educational process trainer pressure, level, flow, temperature (1 per program)
13. pH skid for EPT (1 per program)
14. PVC valves, ball, check, gate, globe, safety (1 each per program)
15. Simulator software and site licenses (1 software per program with licenses for all lab computers
16. Tool and toolbox (for process operation technicians)
17. Windows-compatible computers with standard accessories and Internet access (1 per student)
18. Integrated office software (word processing, spreadsheet, presentations, and database) (1 license per computer)
19. Laser printer
20. Color printer (inkjet or laser)

NON-CAPITALIZED ITEMS

1. Molecular model kits
2. Basic chemistry lab kit (beakers, flasks, tubing, hydrometers, thermometers, etc.)
3. pH meter
4. Hot plates
5. Bunsen burner

RECOMMENDED INSTRUCTIONAL AIDS

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

1. 32-in. LCD monitor/television
2. VCR/DVD player
3. Smart board
4. Windows notebook computer
5. LCD projector
6. Digital camera

7. Optical scanner
8. Copy machine

Assessment

This program is assessed using the MS-CPAS. The following blueprint summary contains the courses that are measured when assessing this program. Courses are grouped into *clusters*, and a weight is given to each cluster to determine the number of items needed from each cluster. The numbers of C1s and C2s (item difficulty levels) are also indicated on the blueprint. This blueprint becomes effective Spring 2010.

Cluster/Competency	Level 1 (C1)	Level 2 (C2)	TOTAL	%
Cluster 1: Introduction and Safety PPT 1133 Introduction to Process Technology PPT 1513 Safety, Health, and Environment	14	4	18	18%
Cluster 2: Process Instrumentation PPT 1714 Process Instrumentation I PPT 2724 Process Instrumentation II	17	8	25	25%
Cluster 3: Process Technology PPT 1424 Process Technology I: Equipment PPT 1434 Process Technology II: Systems PPT 1444 Process Technology III: Operations	32	6	38	38%
Cluster 4: Quality PPT 2313 Quality Concepts PPT 2323 Process Troubleshooting	12	7	19	19%
TOTAL QUESTIONS:	**75**	**25**	**100**	**100%**

Appendix A: Center for the Advancement of Process Technology Standards[1]

Standards for Process Technology programs are based on the occupational and technical knowledge and skills statements needed to perform critical work function as published by the Center for the Advancement of Process Technology.

Abbreviation	Skill Standard Name and Definition
Ads	Adsorption: Understanding of adsorption fundamentals (capacity, saturation, regeneration, pressure differential) and paced or plate adsorption systems (e.g., ionic exchange, demineralizing, anthracite filters, and zeolites)
Bat	Batch reaction: Understanding of batch reaction fundamentals (e.g., levels, temperature, reaction rate, feed quality and consistency, pressures, catalyst, agitation)
Boi	Boiler feed water: Understanding of boiler feed water fundamentals (e.g., pressures, phase change/flash point, uses, sources) and boiler feed water systems (e.g., deaerators, softeners, accumulators, demins, blow downs, condensate return)
Con	Continuous reaction: Understanding of continuous reaction fundamentals (e.g., flow temperature, reaction rate, feed quality and consistency, catalysts and pressures) and continuous reaction systems (e.g. definitions of a fixed bed, liquid, catalyst, injection, fluidized bed)
Coo	Cooling water: Understanding cooling H_2O fundamentals (e.g., rate of evaporation, pH, conductivity, micro-bio content, chemical injection) and cooling water systems (e.g. counter flow, cross flow, temperature control)
Dec	Decanting: Understanding of decanting fundamentals (e.g., specific gravity, residence time, interface, skimming)
Deh	Dehydration: Understanding of dehydration fundamentals (e.g., drying medium temperature, psychometry—study of air/water/vapor, direct/indirect drying) and the purpose and types of dehydration systems (e.g., spray drier, rotary vacuum drier, and tray drier.)
Dra	Use process drawings: Interpret and sketch process diagrams (e.g., block/flow, process flow, and P&ID) in order to trace and learn systems and to aid communication.
EGD	Electrical generation/distribution: Understanding of electrical power generation (e.g., turbines, generators, auxiliary equipment, voltage, currents, Ohms, excitation, MCC-motor control center, emergency backup supply) and power generation sources (e.g., cogen, auxiliary equipment, boilers, and turbines)
Eqp	Equipment monitoring: Conduct physical inspections of equipment (e.g., tanks, pipes, drums, pumps, vents, and safety equipment).
Ext	Extraction: Understanding of extraction fundamentals (e.g., distribution coefficient, solubility, specific gravity, interface) and liquid/liquid, liquid/solids, recycle streams, counter current, cross current, and batch/continuous systems
FHH	Fired heaters/furnaces: Knowledge of fired heat/furnace fundamentals (e.g., heat transfer, flame impinging) and systems (e.g., induced draft, forced draft, convection section, radiant section, shock bank, cross flow, dampner, air registers)

[1] Adapted from *Chemical/refining process technician skill standards*. (2005). Retrieved March 28, 2006, from http://www.captech.org/pdfs/CRSkillStandards.pdf

Fl	Fuels: Understanding of fuel fundamentals—liquids, solids, gases (e.g., sources, types, fluctuations in makeup, BTU)—and fuel system components (e.g., regulators, knockouts, mixing areas, scrubbers, backup systems, vaporizers, atomizers, conveyors)
Flr	Flare: Understanding of flare fundamentals (e.g., density, process variables, emissions, opacity, sweep gas) and the purpose and types of flare systems (e.g., ground flare, vertical flare, equipment)
Haz	Hazard labeling: Knowledge of standard labeling systems (e.g., NFPA for equipment)
Hea	Heat exchangers: Understanding of heat exchanger fundamentals (e.g., temperature changes, conduction, convection, fouling, leaks, thermo-siphon) and types of heat exchangers (e.g., shell-tube, single pass, multiple pass, floating head, condensers, Gfin, Plate and frame, Fin fan, and cooling mediums)
HMB	Heat or material balances: Calculate heat and/or material balance for quality and cost optimization.
Ins	Instrument air: Understanding of instrument air fundamentals (e.g., compression, dewpoint, filtration, system pressure) and instrument air systems (e.g., driers, filters, cycles, compressors, dessicant filters, switching, receivers, KO pots, backups—N_2 utility air)
ICS	Instrumentation and control systems: Knowledge of measurement controls (indicators, recorders, and gauges), instrumentation (e.g., manual, automatic, cascade, and ratio) and distributive control systems (DCS)
Inv	Inventory control: Knowledge of inventory control fundamentals and their impact
MQ	Maintain quality: Optimize process systems by acquiring data and making adjustments.
Mat	Material sampling: Knowledge of sampling techniques and of proper labeling procedures for samples collected
N	Nitrogen: Understanding of nitrogen fundamentals (e.g., inert, properties, hazards, uses, sources) and nitrogen systems (e.g., regulators, knock-out pots, generators—varies by site, compressors, analyzers, O_2 content)
NG	Natural gas: Understanding of natural gas fundamentals (e.g., properties and chemistry of natural gas, uses—blanketing, fuel processes, sources—local utilities, pipelines) and natural gas systems (e.g., pilot gas, compressors, regulators, KO pots, emergency shutdowns)
Op	Operating parameters: Knowledge of normal operating procedures and design limits and the differences between them
PPE	Personal protective equipment: Knowledge of personal protective equipment and its appropriate use
Prc	Procedures: Understand and follow established procedures to operate safely, efficiently, and in an environmentally sound manner (e.g., emergency start-up, shutdown, SOP, LOTO, emissions violations, and other OSHA regulated procedures).
Pro	Process variables: Knowledge of effects and relationships of process variables such as pressure, composition, temperature, level, and flow
Qa	Quality assurance: Interpret and verify quality (e.g., certificate of analysis) and quantity when receiving materials.
Rf	Refrigeration: Understanding of refrigeration fundamentals (e.g., energy transfer, sensible heat, latent heat, refrigerants, refrigeration expansion/contraction cycle) and

	the purpose and types of refrigeration systems (e.g., adsorption and mechanical steam driven, turbine, or electric motor
SEO	Safety equipment operations: Knowledge of operating safety equipment
SHE	Safety, health, and environment: Understand incidents, hazards (e.g. electrical, physical, chemical, biological, environmental), risks (e.g., releases, equipment failure, chemical incompatibility, and other exposures), audits, investigations, and unsafe work practices, and awareness of critical federal, state, and local regulations (e.g., OSHA, EPA, USCG, and DOT; read and interpret MSDS sheets) in order to help ensure compliance with the regulations.
Stc	Steam condensate: Understanding of condensate fundamentals (e.g., condensate purity, system pressure, uses, sources) and condensate systems (e.g., flash tanks, drain pots, desuper heater, steam traps, analyzers, let down stations)
Stg	Steam generation/distribution: Understanding of steam generation fundamentals (e.g., BFW—boiler feed water quality; superheaters, dry vs. wet steam, excess O_2 control, excess O_2 fuel air control; pressure–temperature relationship; boiler level; shrink and swell; three-element control) and the purpose and types of steam generation systems (e.g., drafts—natural, forced, balanced, induced fire-tubed, water-tubed, tube and shelf; source of heat—gas, oil, coal, electrical, dual fuel, and waste heat), and the understanding of steam distribution (e.g., headers, pressure let down, steam traps, and condensate recovery)
Sym	Process symbols: Understand symbols used in process diagrams.
Sys	System components: Knowledge of the system components and their functions (e.g., stationary equipment, rotating equipment, instrumentation, and controls)
Trb	Troubleshooting: Ability to recognize a problem, collect and analyze information, define a root cause, and take an appropriate plan of action
Wat	Water systems: Understanding of fundamentals of water systems (e.g., potable, process, utility, fire, service, storm, waste) and water systems components (e.g., filtration, clarification, tanks, aeration, reverse osmosis, demineralization, and deionization)
Wst	Waste incineration: Understanding of waste incineration fundamentals (e.g., air emissions, excess O_2, NO_x, VOC, phases of waste, temperature) and the purpose and types of waste incineration systems (e.g., natural, balanced or induced draft, solid/vapor/liquid incinerators)

Appendix B: Related Academic Standards[2]

Reading

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5 Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)

Mathematics Computation

M1 Addition of Whole Numbers (no regrouping, regrouping)
M2 Subtraction of Whole Numbers (no regrouping, regrouping)
M3 Multiplication of Whole Numbers (no regrouping, regrouping)
M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations

Applied Mathematics

A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)

Language

L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)

Spelling

S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

[2] CTB/McGraw-Hill LLC. (1994). *Tests of adult basic education, forms 7 and 8.* Monterey, CA: Author.

Appendix C: 21st Century Skills[3]

CS1 Global Awareness

- Using 21st century skills to understand and address global issues
- Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
- Promoting the study of non-English language as a tool for understanding other nations and cultures

CS2 Financial, Economic, and Business Literacy

- Knowing how to make appropriate personal economic choices
- Understanding the role of the economy and the role of business in the economy
- Applying appropriate 21st century skills to function as a productive contributor within an organizational setting
- Integrating oneself within and adapting continually to the nation's evolving economic and business environment

CS3 Civic Literacy

- Being an informed citizen to participate effectively in government
- Exercising the rights and obligations of citizenship at local, state, national, and global levels
- Understanding the local and global implications of civic decisions
- Applying 21st century skills to make intelligent choices as a citizen

CS4 Information and Communication Skills

- Information and media literacy skills: Analyzing, accessing, managing, integrating, evaluating, and creating information in a variety of forms and media; understanding the role of media in society
- Communication skills: Understanding, managing, and creating effective oral, written, and multimedia communication in a variety of forms and contexts

CS5 Thinking and Problem-Solving Skills

- Critical thinking and systems thinking: Exercising sound reasoning in understanding and making complex choices, understanding the interconnections among systems
- Problem identification, formulation, and solution: Ability to frame, analyze, and solve problems
- Creativity and intellectual curiosity: Developing, implementing, and communicating new ideas to others, staying open and responsive to new and diverse perspectives

CS6 Interpersonal and Self-Directional Skills

- Interpersonal and collaborative skills: Demonstrating teamwork and leadership, adapting to varied roles and responsibilities, working productively with others, exercising empathy, respecting diverse perspectives
- Self-direction: Monitoring one's own understanding and learning needs, locating appropriate resources, transferring learning from one domain to another
- Accountability and adaptability: Exercising personal responsibility and flexibility in personal, workplace, and community contexts; setting and meeting high standards and goals for oneself and others; tolerating ambiguity

[3] *21st century skills.* (n.d.). Washington, DC: Partnership for 21st Century Skills.

- Social responsibility: Acting responsibly with the interests of the larger community in mind; demonstrating ethical behavior in personal, workplace, and community contexts