Washtenaw Community College Comprehensive Report

SCI 102 Applied Science
Effective Term: Fall 2022

Course Cover

College: Math, Science and Engineering Tech
Division: Math, Science and Engineering Tech
Department: Physical Sciences
Discipline: Sciences
Course Number: 102
Org Number: 12350
Full Course Title: Applied Science
Transcript Title: Applied Science
Is Consultation with other department(s) required: No
Publish in the Following: College Catalog , Time Schedule , Web Page
Reason for Submission: Course Change
Change Information:
Consultation with all departments affected by this course is required.
Course description
Credit hours
Total Contact Hours
Rationale: Updating the current course for full approval.
Proposed Start Semester: Winter 2022
Course Description: In this course, students will identify the principles of basic science and physics as they apply to the handling, installation, and repair of mechanical equipment in the piping industry. Students will study the concepts, properties, and characteristics of fluids (including water, hydraulics, pneumatics, metals and alloys) and corrosion through classroom problem-solving calculations and lab activities. Using mathematical computations to determine volumes, change of state, and the effects of temperatures and pressures will also be discussed. In addition, students will recognize the relationships of these sciences to understand the mechanical advantages of simple and compound machines as well as the benefits gained through measured work and horsepower. This course is open only to apprentices in the United Association.

Course Credit Hours

Variable hours: Yes
Credits: 0 – 3
Lecture Hours: Instructor: 45 **Student:** 45
Lab: Instructor: 15 **Student:** 15
Clinical: Instructor: 0 **Student:** 0

Total Contact Hours: Instructor: 0 to 60 **Student:** 0 to 60
Repeatable for Credit: NO
Grading Methods: Letter Grades
Audit
Are lectures, labs, or clinicals offered as separate sections?: NO (same sections)

College-Level Reading and Writing

College-level Reading & Writing

College-Level Math

Requisites

Prerequisite

Academic Reading and Writing Levels of 6; Member of the United Association

General Education

General Education Area 4 - Natural Science

Assoc in Applied Sci - Area 4

United Associate students only

Request Course Transfer

Proposed For:

Student Learning Outcomes

1. Identify the properties and characteristics of water and metals as they relate to pressure, temperature, states of matter, density, and molecular structure.
   Assessment 1
   Assessment Tool: Outcome-related test questions
   Assessment Date: Spring/Summer 2022
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 80% of the students will score 80% or higher.
   Who will score and analyze the data: U.A. instructors

2. Identify the properties and characteristics of fluids and gases as they relate to volume, pressure, and temperature relationships, vacuums, and flow rates through piping systems.
   Assessment 1
   Assessment Tool: Outcome-related test questions
   Assessment Date: Spring/Summer 2022
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 80% of the students will score 80% or higher.
   Who will score and analyze the data: U.A. instructors

3. Identify the mechanics and relationships of force, work, distance, horsepower, and mechanical advantage as they apply to simple and compound machines.
   Assessment 1
   Assessment Tool: Outcome-related test questions
   Assessment Date: Spring/Summer 2022
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 80% of the students will score 80% or higher.

Who will score and analyze the data: U.A. instructors

4. Identify the properties and characteristics of metals, metal alloys, and synthetic piping materials and their ductility, malleability, compression, shear strength, and thermal expansion.
   Assessment 1
   Assessment Tool: Outcome-related test questions
   Assessment Date: Spring/Summer 2022
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 80% of the students will score 80% or higher.
   Who will score and analyze the data: U.A. instructors

5. Identify the types, forms, process, and prevention of corrosion and its effects on mechanical piping systems.
   Assessment 1
   Assessment Tool: Outcome-related test questions
   Assessment Date: Spring/Summer 2022
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 80% of the students will score 80% or higher.
   Who will score and analyze the data: U.A. instructors

Course Objectives

1. Compare and contrast the structure and components of atom, molecules, elements, compounds, mixtures, and solutions.
2. Identify the three physical states of matter.
3. Calculate area and volumes of given surfaces and containers.
4. Calculate the density of a substance and determine its buoyancy.
5. Recognize and calculate specific heat, sensible heat, and latent heat and their relationship to the three states of matter.
6. Explain the effects of heat and pressure on different states of matter.
7. Identify and calculate temperatures between the four temperature scales.
8. Calculate the number of BTU's needed to convert a given state of matter to another state at varying pressures.
9. Discuss and give examples of the application of Bernoulli's principle.
10. Differentiate between density, specific gravity and weight density.
11. Explain kinetic energy and its relationship to molecular structure and heat transfer.
12. Identify steam properties, saturation points, superheated steam, and their volumes to varying temperatures and pressures.
13. Discuss compression and expansion of gases in relationship to temperatures.
14. Describe the function of a barometer in relationship to atmospheric pressure.
15. Discuss fluid dynamics, and the relationship of pressure to velocity for fluid flow in piping systems.
16. Convert inches of mercury to pounds per square inch.
17. Calculate the pressure in piping systems under varying conditions.
18. Calculate the discharge pressure of pumps in psia (pounds per square inch absolute) and psig (pounds per square inch gauge) at varying barometric pressures.
19. Identify Boyle's law and the relationship to mechanical piping systems.
20. Explain siphonic action.
21. Discuss the relationship between work, force, and distance.

22. Differentiate between work and power.
23. Calculate force, distance, time, power, and horsepower.
24. Identify the six different types of simple machines.
25. Apply the concepts of work and energy to create mechanical advantage.
26. Describe friction loss and its affects to simple and compound machines.
27. Identify the standard unit of power.
28. Calculate mechanical advantage for simple and compound machines.
29. Discuss the characteristics and properties of elementary metals.
30. Identify the common metals used in piping industry.
31. Differentiate between ferrous and non-ferrous metals.
32. Discuss and calculate thermal (linear) expansion and contraction of common piping materials in relationship to varying temperatures and pressures.
33. Define the characteristics and properties of alloys used in piping systems.
34. Discuss the ductility, malleability, tensile strength, compressive strength and shear strength of piping metals and alloys.
35. Discuss the processes of annealing, hardening, and tempering of metals and alloys.
36. Define the term synthetic as it relates to piping materials.
37. Describe the effects of commonly used fillers in piping systems.
38. Compare the three methods for joining synthetic pipes.
39. Identify and define the six forms of corrosion.
40. Differentiate among the three types of corrosion.
41. Discuss the process and prevention of oxidation.
42. Explain an electrochemical corrosion reaction.
43. Explain how corrosion can be controlled in underground piping systems.
44. Define a galvanic cell.

New Resources for Course

Course Textbooks/Resources

Textbooks

International Pipe Trades Joint Trade Committee. *Related Science*, 3rd ed. IPTJTC, 2006

Manuals

Periodicals

Software

Equipment/Facilities

Reviewer	Action	Date
Faculty Preparer:		
Tony Esposito	*Faculty Preparer*	*Nov 18, 2021*
Department Chair/Area Director:		
Suzanne Albach	*Recommend Approval*	*Dec 04, 2021*
Dean:		
Victor Vega	*Recommend Approval*	*Jan 12, 2022*
Curriculum Committee Chair:		
Randy Van Wagnen	*Recommend Approval*	*Mar 01, 2022*
Assessment Committee Chair:		
Shawn Deron	*Recommend Approval*	*Mar 03, 2022*
Vice President for Instruction:		
Kimberly Hurns	*Approve*	*Mar 04, 2022*

WASHTENAW COMMUNITY COLLEGE

COURSE AND SYLLABUS FORM

Syllabus Cover Sheet

Course Discipline Code & No: SCI 102 **Title:** Applied Science **Effective Term** Winter 2004

Division Code: MNB **Department Code:** PHYD **Org #:**

Don't publish: ☒ College Catalog ☒ Time Schedule ☒ Web Page

Reason for Submission. Check all that apply.

- ☒ New course approval
- ☐ Five-year syllabus review (Attach assessment results.)
- ☐ Major change
- ☐ Minor change (Corrections, editing, clarification)
- ☐ Reactivation of inactive course
- ☐ Inactivation (Submit this page only.)

Change information:

Minor changes

- ☐ Course discipline code & number (was _____) (when changing course number, select "inactivation" to discontinue the old course.)
- ☐ Course title (was _____)
- ☐ Course description
- ☐ Course objectives (minor changes)

For major changes, consultation with all departments affected by this course is required. Attach "course use in programs" report from Curriculum Database for Faculty.

Major changes (reviewed by Curriculum Committee.)

- ☐ Credit hours (credits were: _____)
- ☐ Total Contact Hours (total contact hours were: _____)
- ☐ Distribution of contact hours (contact hours were: lecture: _____ lab _____ clinical _____ other _____)
- ☐ Pre or co-requisites
- ☐ Distance Learning section approval
- ☐ General Education Distribution Course: Add ☐ Remove ☐
- ☐ Honors section approval
- ☐ Change in Grading Method
- ☐ Objectives
- ☐ Other _____

Rationale for course or course change

1. **Assessment-based:**

2. **Non-assessment-based:** Science course needed for general education distribution for apprentice pipefitters who wish to receive an AAS degree.

Approvals Department and divisional signatures indicate that all departments affected by the course have been consulted.

Department Review by Chairperson ☐ New resources needed ☐ All relevant departments consulted

Print: Scott Klapper (Faculty/Preparer) Signature Scott Klapper Date: 12-19-03

Print: Rober Hagood (Department Chair) Signature Robt M. Good Date: 12/19/03

Division Review by Dean ☒ Request for conditional approval

Recommendation ☒ Yes ☐ No M. Howard (Dean's/Administrator's Signature) 12/19/03 (Date)

Curriculum Committee Review

Recommendation _____

☐ Tabled ☐ Yes ☐ No _____ (Curriculum Committee Chair's Signature) _____ (Date)

Vice President of Instruction Approval

Approval ☒ Yes ☐ No Roger M. Paloney (Vice President's Signature) 12/19/03 (Date)

Do not write in shaded area.

ACS Code 115 Entered in: Banner 12/19 C&A Database 12/19 Log File 12/19

Approved for General Education Area/Group _____ Syllabus Date _____ Basic skills table updated ☐

Contact fee ☑

Please return completed form to the Office of Curriculum & Articulation Services.

RECEIVED DEC 05 2003

WASHTENAW COMMUNITY COLLEGE

COURSE AND SYLLABUS FORM

Course Discipline & No.: SCI 102 **Title:** Applied Science

Credit hours: 3
If variable credit, give range:
____ to ____ credits

Instructor contact hours per semester:
Lecture: 45
Lab: 15
Clinical:
Practicum
Other:
Total contact hours: 60

Class capacity:
30
Standard capacity is 30 students unless otherwise specified in the Master Agreement.

Grading options:
☐ P/NP (limited to clinical & practica)
☐ S/U (for courses numbered below 100)
☐ Letter grades

Prerequisites. Select one:
☒ College-level Reading & Writing
☐ Reduced Reading/Writing Scores
COMPASS Reading ____
COMPASS Writing ____
☐ No Basic Skills Prerequisite
(College-level Reading and Writing is not required.)

In addition to Basic Skills in Reading/Writing:

Level I (enforced in Banner)

	Course/Test	Grade/Score	Concurrent Enrollment
			☐
☐ and ☐ or			☐
☐ and ☐ or			☐
☐ and ☐ or			☐

Corequisites (must be enrolled in this class also during the same semester):
____
____

Level II (enforced by instructor on first day of class)

	Course	Grade/Score
☐ and ☐ or		
☐ and ☐ or		
☐ and ☐ or		

Enrollment restrictions (In addition to prerequisites, if applicable.)
☐ and ☐ or ☐ Instructor consent required
☐ and ☐ or ☐ Admission to program required
Program ____
☐ and ☐ or ☐ Other (please specify):
Member of United Association

Please send syllabus for transfer evaluation to:
☐ EMU
☐ UM
☐ ____
☐ ____
☐ ____
☐ ____

Instructional mode
☒ On campus
☐ Online
☐ Blended (online and on-campus combined)
☐ ITV
☐ Other

Course Options
General Education Group I
(Select one area)
☐ Writing ☐ Nat. Sci.
☐ Speech ☐ Soc./Behav/ Sci.
☐ Math ☐ Arts/Hum.

Courses must meet all criteria.
☒ 1. Is a standard introductory course in the discipline
☐ 2. Has a verified transfer acceptance
☒ 3. Meets the critical thinking requirement
☒ 4. Assesses academic achievement
☒ 5. Covers minimum knowledge/skills

Honors section. Not all criteria are required. Check relevant items.
☐ 1. Emphasis on primary source materials
☐ 2. Emphasis on independent study/research
☐ 3. Greater rigor of course materials
☐ 4. Interdisciplinary approach
☐ 5. Development of critical thinking skills
☐ 6. Additional course objectives
☐ 7. Additional instructional methods
☐ 8. Satisfaction of the service component

List all new resources needed for course, including library materials.

WASHTENAW COMMUNITY COLLEGE

COURSE AND SYLLABUS FORM

Syllabus

Course discipline code & number	Course title	Credit hours
SCI 102	Applied Science	3

Course description Brief statement of the purpose and content of the course	This course prepares members of the pipe trades to accurately apply principles of physics to their work. Five major areas are studied: water and steam; hydraulics and pneumatics; mechanics; metals, alloys, synthetics; and corrosion. Within each of these areas, apprentices will develop their understanding of the concepts underlying the various aspects of their trade so that they can perform to accepted standards. This course is open only to apprentices in the United Association.

Course outcomes

List brief statements that indicate what students will know and be able to accomplish as a result of taking the course. Indicate how these outcomes will be assessed for NCA assessment of student achievement.

Outcomes	Assessment Method
By the end of this course, apprentices will: 1. Solve problems related to the pipe trades by applying their knowledge in the following areas: •Nature and properties of substances transported by piping systems. •Properties of liquids and gases in motion through piping systems •Nature of forces involved in work and machines •Properties of materials used in piping installations. •Causes of corrosion and the means to control it. 2. Use proper techniques to calculate, design, install, and maintain appropriate piping systems.	Instructor observation of student performance using a standard UA checklist. RMA.

Content outline

List in sequence the instructional units/modules/clusters of related topics that will be taught, and indicate the major instructional objectives for each unit. Indicate methods that will be used in each unit to evaluate student work for grading.

Unit and Unit Objectives	Evaluation Method
Unit 1 Water and Steam Objectives 1. Describe the structure and components of atom and molecules. 2. Identify the three physical states of matter. 3. Differentiate among substance, matter, element, compound, mixture, and solution. 4. List five elements used in the piping industry. 5. Calculate the volume of a tank in liters. 6. Calculate the density of a substance using the concept of buoyancy. 7. Determine the specific heat of different substances. 8. Explain the effects of heat and pressure on different states of matter. 9. Convert degrees of temperature in the three temperature scales to degrees in the other scales. 10. Differentiate among latent, specific, and sensible heat. 11. Determine the boiling point of water at varying pressures. 12. Calculate the number of BTUs needed to convert a given state	-Midterm -Final -Lab and other projects -Homework assignments RMA (At least 10 graded assignments will be distributed across the term.) RMA (Each objective will be evaluated in at least one graded assignment.)

of matter to another state, at varying pressures.

13. Explain the energy changes involved in freezing and evaporation.

14. Give an example of the application of Bernoulli's principle.

15. Differentiate among density, specific gravity, and weight density.

16. Explain why some substances are more dense than others.

17. Explain the kinetic theory of temperature.

18. Give examples of heat transfer, conduction, and radiation.

19. Contrast superheated steam to saturated steam.

20. Calculate the saturation temperature of water.

21. Calculate the temperature and volume of steam at varying pressures.

Unit 2

Hydraulics and Pneumatics

1. Explain how a gas can be heated and cooled by compression and expansion.

2. Describe the function of a barometer in relationship to atmospheric pressure.

3. Solve problems using the concept of fluid dynamics.

4. Explain fluid flow.

5. Explain the relationship of pressure to velocity for a fluid flowing in a pipe.

6. Represent and solve problems related to principles of fluids.

7. Convert inches of mercury to pounds per square inch.

8. Calculate the pressure in piping systems under varying conditions.

9. Calculate the discharge pressure of pumps in psia and psig at varying barometric pressures.

10. Explain how Boyle's law relates to work in the pipe trades.

11. Calculate the absolute pressure in containers, given a certain psig, at varying barometric pressures.

12. Given a cylinder with a certain volume of air at a specified psia, determine the volume of air if it compressed to a lower psia.

13. Explain siphonic action.

Unit 3

Mechanics

Objectives

1. Explain the relationship of the terms work, force, and distance.

2. Differentiate between work and power.

3. Express the relationship of force, distance, time, and power in a simple equation.

4. Calculate horsepower.

5. Define the term machine.

6. Explain two common uses of machines.

7. Identify the six different types of simple machines.

8. Apply the concepts of work and energy to machines.

9. Describe how each of the three classes of levers handles effort and resistance.

10. Explain the meaning of the statement, "work input equals work output."

11. Describe how friction affects machines (or the work of machines).

12. Identify the standard unit of power.

13. Represent and solve problems related to the use of machines in the pipes trades.

14. Explain the concept of mechanical advantage.

15. Compute the mechanical advantage for simple and compound machines.

Unit 4

Metals, Alloys, and Synthetics

Metals Objectives

1. List the essential characteristics of an elementary metal.

2. Identify the characteristics of the common elemental metals used in piping industry.

3. List the mechanical properties of metals that are the effects of force.

4. List the physical properties of metals.

5. Identify the properties of ferrous metals.

6. Explain how the coefficient of thermal (linear) expansion and contraction is used in designing piping installations.

7. Explain how the differential expansion of metals can used to monitor and temperature

Alloys Objectives

1. Define the term alloy.

2. Identify the characteristics of the common alloys used in piping installations.

3. Explain the purpose of alloying metals.

4. Define the following properties of metals: ductibility, malleability, tensile strength, compressive strength, and shear strength.

5. Explain the following processes: annealing, hardening, and tempering.

Synthetics Objectives

1. Define the term synthetic as it relates to piping materials.

	2. Identify the characteristics of the commonly used synthetics for piping. 3. Describe the effects of commonly used fillers on the physical properties of piping materials. 4. Explain the external factors that affect synthetic piping materials. 5. Compare the three methods for joining synthetic pipes. 6. Describe the effects of temperature on synthetic piping materials. 7. Differentiate among the four different methods used to compensate for expansion and contraction in synthetic pipes. 8. Explain the factors to consider in determining the support necessary for a synthetic piping system. Unit 5 Corrosion Objectives 1. Define corrosion. 2. Identify six forms of corrosion. 3. Differentiate among the three types of corrosion. 4. Explain how oxidation and reduction occur. 5. Explain an electrochemical corrosion reaction. 6. Explain how corrosion can be controlled in underground piping systems. 7. Define a galvanic cell. 8. List guidelines for combating corrosion.

COURSE AND SYLLABUS FORM

Student Materials

List examples of types		**Estimated costs.**
Texts Supplemental reading Supplies Uniforms Equipment Tools Software		$

Equipment/Facilities: Check all that apply. (All classrooms have overhead projectors and permanent screens.)

Check level only if the specified equipment is needed for all sections of a course.

- ☐ Level I classroom
  Permanent screen & overhead projector
- ☐ Level II classroom
  Level I equipment plus TV/VCR
- ☐ Level III classroom
  Level II equipment plus data projector, computer, faculty workstation

- ☐ Off-Campus Sites
- ☐ Testing Center
- ☐ Computer workstations/lab
- ☐ ITV
- ☐ TV/VCR
- ☐ Data projector/computer
- ☐ Other _____