

# Mechanical-Electrical Technology MET

Associate in Science Degree  
Certificate of Achievement

Mechanical-Electrical Technology, Degree and Certificate of Achievement

Commercial Building Energy Auditing and Commissioning Specialist, Certificate of Achievement

Wastewater Treatment Plant Operation, Degree and Certificate of Achievement

Water Treatment Plant Operation, Degree and Certificate of Achievement

Mechanical Systems Technician, Certificate of Achievement

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## Program Information

The Mechanical-Electrical Technology (MET) program provides instruction in design, installing, operating, and maintenance of a wide range of mechanical and electrical equipment. These systems include heating, ventilating, air conditioning, and refrigerating (HVAC/R); solar photovoltaic and solar hot water; and water and wastewater systems. Areas of instruction include: energy management, mechanical system commissioning, indoor air quality, building automation systems, heating, cooling, heat pumps, refrigeration, refrigerant recovery and management, electrical controls, pneumatic controls, electronic controls, instrumentation, solar photovoltaic, solar hot water and wind energy, and the operation of water and wastewater treatment plants.

Students learn the skills and concepts necessary to install, operate, maintain, repair, and manage various mechanical and electrical systems from small residential equipment to large commercial and industrial facilities. Effective writing, verbal communication, electronic communication, sketching, drafting, mechanical calculations, and computer skills are emphasized across the curriculum.

The program includes both day and evening lecture and laboratory sections and is designed to give students a solid foundation in general installation, operation, maintenance, repair, and equipment management skills included in HVAC/R, renewable and sustainable energy, and water and wastewater industries. Students will not only learn the theory and fundamentals of mechanical equipment, but also be exposed to hands-on training in sophisticated training laboratories. Laboratory equipment students will work with include: a water cooled chiller, cooling towers, steam and hot water boilers, thermal energy storage system, heat reclaim system, power management system, solar photovoltaic and solar hot water systems, packaged and split system air conditioners, furnaces, and high and low temperature refrigeration systems. Students will also configure, program, and commission several Direct Digital Control (DDC) Systems, pneumatic systems, and programmable logic controllers (PLC) on state-of-the-art computer stations, and work directly on the operating systems in the laboratory facility.

The Mechanical-Electrical Technology Associate in Science Degree focuses on the skills and concepts necessary to install, operate, maintain, repair, and manage various mechanical and electrical systems from small residential equipment to large commercial and industrial facilities. The entire spectrum of mechanical and electrical systems will be covered including energy management, mechanical system commissioning, indoor air quality, building au-

tomation systems, refrigerant recovery and management, electrical controls, pneumatic controls, electronic controls, instrumentation, heat pumps, solar photovoltaic, solar hot water, and wind energy systems, and water and wastewater treatment systems. Effective writing, verbal communication, electronic communication, sketching, drafting, mathematical calculations and computer skills will be emphasized throughout the program.

Certificates of Achievement are awarded to students who satisfactorily complete the various programs. Students completing the programs may also qualify for an Associate of Science degree. Certificates are offered in Mechanical-Electrical Technology, Wastewater Treatment Plant Operation, Water Treatment Plant Operation, Commercial Building Energy Auditing and Commissioning Specialist, and Mechanical Systems Technician. Preparation for the federal refrigerant transition and recovery license examination is also offered.

Classes are studied in both lecture and laboratory. Mathematics, science, drafting and technical writing, which are all related to the programs, are also studied.

## Mechanical-Electrical Technology

Associate in Science Degree  
Certificate of Achievement

### Career Opportunities

Upon completion of the MET program, students may find employment in the following industry sectors: government (federal, state, county, and city agencies), health care, utilities, construction, facilities management, engineering, high technology, food production, and manufacturing. Typical job titles include: stationary engineer, air conditioning and refrigeration technician, maintenance mechanic, boiler operator, water or wastewater treatment plant operator, automatic control technician, solar, photovoltaic, wind (renewable and sustainable) energy technician, wholesale and manufacturer's sales representative.

### Recommended High School Preparation

Completion of college preparatory English and general mathematics courses are highly desirable, but not required. Courses in drafting, algebra, and computer fundamentals will be beneficial.

**Program Costs**

In addition to normal student expenses such as tuition and textbooks, MET students must purchase safety glasses for use in laboratory and shop classes. If this fee creates a financial burden, students should consult the Financial Aid Office for possible assistance.

**Upon completion of this program, the student will be able to:**

- apply problem-solving and analytical thinking skills in the maintenance, operation, testing, troubleshooting, and repair of heating, cooling and refrigeration systems, accessories, and controls.
- utilize tools and equipment in the maintenance, operation, testing, troubleshooting and repair of heating, cooling and refrigeration systems, accessories, and controls.
- demonstrate an understanding of the industry required Federal Refrigerant Transition and Recovery Certification license examination.
- recognize the importance of proper handling of refrigerants and the environmental impact of improper refrigerant management.
- operate and troubleshoot a hot water and high pressure steam boiler system, pumping and piping systems, and related heating equipment.
- design a heating-cooling system for a residential and commercial application from concept to finish.
- demonstrate an understanding of chilled water systems, air distribution, variable air volume systems thermal storage, cooling towers, and energy management.
- explain the concepts related to absorption air conditioning systems, helical-rotary, and centrifugal water chillers.
- demonstrate an understanding of electrical circuits and controls.
- design an electrical control schematic and troubleshoot various electrical equipment.
- utilize freehand sketching and drafting skills for use in field applications.
- demonstrate an understanding of different types, application and proper use of instruments to measure and record temperature, humidity, flow, light, sound, velocity, pressure, combustion emissions, air quality, voltage, level, force, and vibration.
- analyze complex systems of the Automatic Controls industries.
- design and program Automatic Control systems, Direct Digital Control systems, and Pneumatic Control systems.
- demonstrate the skills and knowledge necessary to be successful in Automatic Controls industries.
- analyze manufacturer's data of equipment performance and economic factors related to heating, cooling and refrigeration equipment, and estimate the cost of a refrigeration system installation including materials, labor, and profit.
- solve problems involving heat transfer, heating and cooling loads, air distribution, and psychometrics of air.
- evaluate and determine the need for periodic equipment maintenance, design a mechanical system maintenance program, and demonstrate an understanding of a maintenance contract.
- explain the concepts of potable water and wastewater treatment systems and processes.
- demonstrate an understanding of water resources and their preservation, treatment system components, related operation, and safety practices.
- install, operate, maintain, and troubleshoot various types of renewable and sustainable energy systems.

**Required Program****Units**

MET 255 Mechanical Systems Maintenance .....	1.5
MET 256 Fundamentals of Instruments and Electricity.....	1.5
MET 257 Fundamentals of Workplace Success.....	1.5
MET 351 Basic Mechanical Systems .....	5
MET 352 Mechanical Systems Calculations .....	3
MET 361 Refrigeration Systems.....	3
MET 362 Refrigeration Systems Calculations .....	3
MET 363 Refrigerant Transition and Recovery Processes and Procedures .....	1.5
MET 364 Electrical Controls.....	3
MET 371 Heating and Power Machinery.....	3
MET 372 Power Machinery, Heating and Air Conditioning Calculations .....	3
MET 373 Piping, Electrical, and Sheet Metal Drafting .....	3
MET 374 Automatic Control Systems I.....	3
MET 381 Air Conditioning .....	3
MET 383 Instrumentation.....	3
MET 384 Automatic Control Systems II .....	3
MET 368 Heat Pump Operation and Maintenance .....	3
<b>Total Units Required</b>	<b>47</b>

**Suggested Elective**

PHYS 310

**Associate in Science (A.S.) Degree**

The Associate in Science Degree may be earned by completion of the required program with grades of "C" or better, plus general education requirements, plus sufficient electives to meet a 60-unit total. See SCC graduation requirements.

**Certificate of Achievement**

The Certificate of Achievement may be obtained by completion of the required program with grades of "C" or better.

**Suggested Semester Sequence****First Semester**

MET 255 Mechanical Systems Maintenance .....	1.5
MET 256 Fundamentals of Instruments and Electricity.....	1.5
MET 257 Fundamentals of Workplace Success.....	1.5
MET 351 Basic Mechanical Systems .....	5
MET 352 Mechanical Systems Calculations .....	3

**Second Semester**

MET 361 Refrigeration Systems.....	3
MET 362 Refrigeration Systems Calculations .....	3
MET 363 Refrigerant Transition and Recovery Processes and Procedures .....	1.5
MET 364 Electrical Controls.....	3
MET 368 Heat Pump Operation and Maintenance .....	3

**Third Semester**

MET 371 Heating and Power Machinery.....	3
MET 372 Power Machinery, Heating and Air Conditioning Calculations .....	3
MET 373 Piping, Electrical, and Sheet Metal Drafting .....	3
MET 374 Automatic Control Systems I.....	3

**Fourth Semester**

MET 381 Air Conditioning .....	3
MET 383 Instrumentation .....	3
MET 384 Automatic Control Systems II .....	3

## Commercial Building Energy Auditing and Commissioning Specialist Certificate of Achievement

### Program Information

The Commercial Building Energy Auditing and Commissioning Specialist Certificate of Achievement is designed to meet the high industry demand for the unique skills necessary in managing energy and the commissioning of new and existing facilities. United States Green Building Council has proclaimed Commissioning to be mandatory to achieve Leadership in Energy and Environmental Design (LEED) certification. This program will help students meet the new Energy and Building Commissioning standards and is designed to help the student learn the information and skills necessary to begin working in the industry. Safety, environmental impact issues, indoor air quality, and equipment maintenance and operation will be emphasized throughout the program.

To obtain the Commercial Building Energy Auditing and Commissioning Specialist Certificate of Achievement at Sacramento City College, a student must complete all of the courses in the Commercial Building Energy Auditing and Commissioning Specialist required program with grades of "C" or better.

### Career Opportunities

Upon completion of the Commercial Building Energy Auditing and Commissioning Specialist Certificate of Achievement, students will be qualified for employment in the following industry sectors: government (federal, state, county, and city agencies), health care, utilities, construction, facilities management, engineering, high technology, food production, and manufacturing. Typical job titles include: commercial building commissioning specialist, commercial energy auditor, energy management and efficiency technician, stationary engineer, air conditioning and refrigeration technician, maintenance mechanic, boiler operator, automatic control technician, solar, photovoltaic, wind (renewable and sustainable) energy technician, wholesale and manufacturer's sales representative.

### Upon completion of this program, the student will be able to:

- demonstrate an understanding of the techniques and practices of commissioning controls and mechanical systems that are used in heating, ventilation, air conditioning, pumping, and water treatment.
- apply knowledge of commissioning to better meet entry level and advanced employment standards.
- commission an HVAC mechanical system and a Direct Digital Control (DDC) system.
- demonstrate an understanding of the techniques and practices of measuring and optimizing the energy efficiency of mechanical systems that are used in heating, ventilating, air conditioning, pumping, and water treatment.
- apply knowledge of how to measure and optimize the energy efficiency of mechanical systems to better meet entry level and advanced employment standards.
- measure and optimize the energy efficiency of an HVAC mechanical system, thermal storage system, and a Direct Digital Control (DDC) system.
- evaluate and improve air conditioning problem-solving skills.
- solve air conditioning system problems with the use of industry specific computer applications.
- design commercial air conditioning systems.
- estimate commercial air conditioning systems.

### Required Program

	Units
MET 391 Mechanical Systems Commissioning .....	3
MET 392 Energy Management and Efficiency for HVAC Mechanical Systems.....	3
MET 393 Commercial Building Energy Audits and Calculations ...	3
MET 396 Air and Water Balance of Mechanical Equipment .....	3
<b>Total Units Required</b>	<b>12</b>

### Certificate of Achievement

A Certificate of Achievement may be obtained by completion of the MET Required Program with grades of "C" or better.

### Suggested Semester Sequence

#### First Semester

MET 391 Mechanical Systems Commissioning .....	3
MET 392 Energy Management and Efficiency for HVAC Mechanical Systems.....	3

#### Second Semester

MET 393 Commercial Building Energy Audits and Calculations ...	3
MET 396 Air and Water Balance of Mechanical Equipment .....	3

## Wastewater Treatment Plant Operation

### Associate in Science Degree Certificate of Achievement

This program focuses on water resources and their preservation, wastewater treatment plant operation and systems, wastewater treatment system components, processes, regulations, and safety practices. In addition, the entire spectrum of mechanical and electrical systems will be covered including energy management, mechanical system commissioning, indoor air quality, building automation systems, electrical controls, pneumatic controls, electronic controls, and instrumentation. Effective writing, verbal communication, electronic communication, sketching, drafting, mathematical calculations, and computer skills will be emphasized throughout the program.

Upon completion of the appropriate wastewater treatment courses in the Mechanical-Electrical Technology Program, a student will be eligible to receive three certificates sponsored by the Office of Water Programs at California State University, Sacramento, and the Mechanical-Electrical Technology Program at Sacramento City College; Operation of Wastewater Treatment Plants I, Operation of Wastewater Treatment Plants II, and Advanced Waste Treatment.

### Career Opportunities

Upon completion of the Wastewater Treatment Plant Operation Associate in Science Degree, students may find employment in the following industry sectors: government (federal, state, county, and city agencies), health care, utilities, construction, facilities management, engineering, high technology, food production, and manufacturing. Typical jobs titles include: wastewater treatment plant operator, stationary engineer, maintenance mechanic, and automatic control technician.

**Upon completion of this program, the student will be able to:**

- demonstrate an understanding of and be prepared to take the Wastewater Treatment Plant Operator Certification Examinations.
- demonstrate an understanding of water resources and their preservation, treatment system components, related operation, and safety practices.
- explain the concepts of wastewater treatment systems and processes.
- apply problem-solving and analytical thinking skills in the maintenance, operation, testing, troubleshooting, and repair of heating, cooling and refrigeration systems, accessories, and controls.
- utilize tools and equipment in the maintenance, operation, testing, troubleshooting and repair of heating, cooling and refrigeration systems, accessories, and controls.
- recognize the importance of proper handling of refrigerants and the environmental impact of improper refrigerant management.
- operate and troubleshoot a hot water and high pressure steam boiler system, pumping and piping systems, and related heating equipment.
- demonstrate an understanding of chilled water systems, air distribution, variable air volume systems thermal storage, cooling towers, and energy management.
- explain the concepts related to absorption air conditioning systems, helical-rotary, and centrifugal water chillers.
- demonstrate an understanding of electrical circuits and controls.
- design an electrical control schematic and troubleshoot various electrical equipment.
- utilize freehand sketching and drafting skills for use in field applications.
- demonstrate an understanding of different types, application and proper use of instruments to measure and record temperature, humidity, flow, light, sound, velocity, pressure, combustion emissions, air quality, voltage, level, force, and vibration.
- analyze complex systems of the Automatic Controls industries.
- design and program Automatic Controls systems, Direct Digital Control systems, and Pneumatic Control systems.
- demonstrate the skills and knowledge necessary to be successful in Automatic Controls industries.
- analyze manufacturer's data of equipment performance and economic factors of mechanical systems.
- solve problems involving heat transfer, heating and cooling loads, air distribution, and psychometrics of air.
- evaluate and determine the need for periodic equipment maintenance, design a mechanical system maintenance program, and demonstrate an understanding of a maintenance contract.

**Required Program****Units**

MET 255 Mechanical Systems Maintenance .....	1.5
MET 256 Fundamentals of Instruments and Electricity.....	1.5
MET 257 Fundamentals of Workplace Success.....	1.5
MET 351 Basic Mechanical Systems .....	5
MET 352 Mechanical Systems Calculations .....	3
MET 354 Wastewater Treatment Plant Calculations.....	3
MET 356 Wastewater Treatment Plant Operation and Maintenance I .....	3
MET 361 Refrigeration Systems.....	3
MET 364 Electrical Controls.....	3

MET 366 Wastewater Treatment Plant Operation and Maintenance II .....	3
MET 371 Heating and Power Machinery.....	3
MET 373 Piping, Electrical, and Sheet Metal Drafting .....	3
MET 374 Automatic Control Systems I.....	3
MET 376 Wastewater Treatment Plant Operation and Maintenance III.....	3
MET 383 Instrumentation.....	3
MET 384 Automatic Control Systems II .....	3
BIOL 444 Water and Wastewater Microbiology .....	3
CHEM 326 Water and Wastewater Treatment Chemistry .....	3

**Total Units Required****51.5****Associate in Science (A.S.) Degree**

The Associate in Science degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See SCC graduation requirements.

**Certificate of Achievement**

A Certificate of Achievement may be obtained by completion of the MET Required Program with grades of "C" or better.

**Suggested Semester Sequence****First Semester**

MET 256 Fundamentals of Instruments and Electricity.....	1.5
MET 257 Fundamentals of Workplace Success.....	1.5
MET 351 Basic Mechanical Systems .....	5
MET 352 Mechanical Systems Calculations .....	3
MET 356 Wastewater Treatment Plant Operation and Maintenance I .....	3

**Second Semester**

MET 255 Mechanical Systems Maintenance .....	1.5
MET 354 Wastewater Treatment Plant Calculations.....	3
MET 361 Refrigeration Systems.....	3
MET 364 Electrical Controls.....	3
MET 366 Wastewater Treatment Plant Operation and Maintenance II .....	3

**Third Semester**

MET 371 Heating and Power Machinery.....	3
MET 373 Piping, Electrical, and Sheet Metal Drafting .....	3
MET 374 Automatic Control Systems I.....	3
CHEM 326 Water and Wastewater Treatment Chemistry .....	3

**Fourth Semester**

MET 376 Wastewater Treatment Plant Operation and Maintenance III .....	3
MET 383 Instrumentation.....	3
MET 384 Automatic Control Systems II .....	3
BIOL 444 Water and Wastewater Microbiology .....	3

## Water Treatment Plant Operation

Associate in Science Degree  
Certificate of Achievement

### Program Information

This program focuses on water resources and their preservation, water treatment plant operation and systems, water treatment system components, processes, regulations, and safety practices. In addition, the entire spectrum of mechanical and electrical systems will be covered including energy management, mechanical system commissioning, indoor air quality, building automation systems, refrigerant recovery and management, electrical controls, pneumatic controls, electronic controls, and instrumentation. Effective writing, verbal communication, electronic communication, sketching, drafting, mathematical calculations, and computer skills will be emphasized throughout the program.

Upon completion of the appropriate water treatment courses in the Mechanical-Electrical Technology Program, a student will be eligible to receive three certificates sponsored by the Office of Water Programs at California State University, Sacramento, and the Mechanical-Electrical Technology Program at Sacramento City College; Water Treatment Plants Operation I, Water Treatment Plants Operation II, and Small Water System Operation and Maintenance.

### Career Opportunities

Upon completion of the Water Treatment Plant Operation Associate in Science Degree, students may find employment in the following industry sectors: government (federal, state, county, and city agencies), health care, utilities, construction, facilities management, engineering, high technology, food production, and manufacturing. Typical jobs titles include: water treatment plant operator, stationary engineer, maintenance mechanic, and automatic control technician.

### Upon completion of this program, the student will be able to:

- demonstrate an understanding of and be prepared to take the Water Treatment Plant Operator Certification Examinations.
- demonstrate an understanding of water resources and their preservation, treatment system components, related operation, and safety practices.
- explain the concepts of water treatment systems and processes.
- apply problem-solving and analytical thinking skills in the maintenance, operation, testing, troubleshooting, and repair of heating, cooling and refrigeration systems, accessories, and controls.
- utilize tools and equipment in the maintenance, operation, testing, troubleshooting and repair of heating, cooling and refrigeration systems, accessories, and controls.
- recognize the importance of proper handling of refrigerants and the environmental impact of improper refrigerant management.
- operate and troubleshoot a hot water and high pressure steam boiler system, pumping and piping systems, and related heating equipment.
- demonstrate an understanding of chilled water systems, air distribution, variable air volume systems thermal storage, cooling towers, and energy management.
- explain the concepts related to absorption air conditioning systems, helical-rotary, and centrifugal water chillers.
- demonstrate an understanding of electrical circuits and controls.
- design an electrical control schematic and troubleshoot various electrical equipment.

- utilize freehand sketching and drafting skills for use in field applications.
- demonstrate an understanding of different types, application and proper use of instruments to measure and record temperature, humidity, flow, light, sound, velocity, pressure, combustion emissions, air quality, voltage, level, force, and vibration.
- analyze complex systems of the Automatic Controls industries.
- design and program Automatic Controls systems, Direct Digital Control systems, and Pneumatic Control systems.
- demonstrate the skills and knowledge necessary to be successful in Automatic Controls industries.
- analyze manufacturer's data of equipment performance and economic factors of mechanical systems.
- solve problems involving heat transfer, heating and cooling loads, air distribution, and psychometrics of air.
- evaluate and determine the need for periodic equipment maintenance, design a mechanical system maintenance program, and demonstrate an understanding of a maintenance contract.

### Required Program

	<b>Units</b>
MET 255 Mechanical Systems Maintenance .....	1.5
MET 256 Fundamentals of Instruments and Electricity.....	1.5
MET 257 Fundamentals of Workplace Success.....	1.5
MET 351 Basic Mechanical Systems .....	5
MET 352 Mechanical Systems Calculations .....	3
MET 353 Water Treatment Plant Calculations .....	3
MET 355 Water Treatment Plant Operation and Maintenance I...	3
MET 361 Refrigeration Systems.....	3
MET 364 Electrical Controls.....	3
MET 365 Water Treatment Plant Operation and Maintenance II..	3
MET 371 Heating and Power Machinery.....	3
MET 373 Piping, Electrical, and Sheet Metal Drafting .....	3
MET 374 Automatic Control Systems I.....	3
MET 375 Water Treatment Plant Operation and Maintenance III.	3
MET 383 Instrumentation.....	3
MET 384 Automatic Control Systems II .....	3
BIOL 444 Water and Wastewater Microbiology .....	3
CHEM 326 Water and Wastewater Treatment Chemistry .....	3

### Total Units Required

**51.5**

### Associate in Science (A.S.) Degree

The Associate in Science degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See SCC graduation requirements.

### Certificate of Achievement

A Certificate of Achievement may be obtained by completion of the MET Required Program with grades of "C" or better.

### Suggested Semester Sequence

#### First Semester

MET 256 Fundamentals of Instruments and Electricity.....	1.5
MET 257 Fundamentals of Workplace Success.....	1.5
MET 351 Basic Mechanical Systems .....	5
MET 352 Mechanical Systems Calculations .....	3
MET 355 Water Treatment Plant Operation and Maintenance I...	3

**Second Semester**

MET 255 Mechanical Systems Maintenance .....	1.5
MET 353 Water Treatment Plant Calculations .....	3
MET 361 Refrigeration Systems.....	3
MET 364 Electrical Controls.....	3
MET 365 Water Treatment Plant Operation and Maintenance II..	3

**Third Semester**

MET 371 Heating and Power Machinery.....	3
MET 373 Piping, Electrical, and Sheet Metal Drafting .....	3
MET 374 Automatic Control Systems I.....	3
CHEM 326 Water and Wastewater Treatment Chemistry .....	3

**Fourth Semester**

MET 375 Water Treatment Plant Operation and Maintenance III.	3
MET 383 Instrumentation.....	3
MET 384 Automatic Control Systems II .....	3
BIOL 444 Water and Wastewater Microbiology .....	3

## Mechanical Systems Technician Certificate of Achievement

**Program Information**

The Mechanical Systems Technician Certificate of Achievement is designed to help the student learn the information and entry-level skills necessary to begin working in the Air Conditioning, Heating, Refrigeration, Water and Wastewater Treatment, and related industries. Safety, environmental impact issues, indoor air quality, and equipment maintenance will be emphasized throughout the program.

To obtain the Mechanical Systems Technician Certificate of Achievement at Sacramento City College, a student must complete all of the courses in the Mechanical Systems Technician required program with grades of "C" or better.

**Career Opportunities**

Upon completion of the Mechanical Systems Technician Certificate of Achievement, students will be qualified for employment in the following industry sectors: government (federal, state, county, and city agencies), health care, utilities, construction, facilities management, engineering, high technology, food production, and manufacturing. Typical jobs titles include: stationary engineer, air conditioning and refrigeration technician, maintenance mechanic, water and wastewater treatment plant operator, automatic control technician, and wholesale and manufacturer's sales representative.

**Upon completion of this program, the student will be able to:**

- evaluate and determine the need for periodic equipment maintenance, design a machinery system maintenance program, and demonstrate an understanding of a maintenance contract.
- apply problem-solving and analytical thinking skills in the maintenance, operation, testing, troubleshooting and repair of heating, cooling and refrigeration systems, accessories and controls.
- utilize tools and equipment in the maintenance, operation, testing, troubleshooting and repair of heating, cooling and refrigeration systems, accessories and controls.
- demonstrate an understanding of the industry required Federal Refrigerant Transition and Recovery Certification license examination.
- recognize the importance of proper handling of refrigerants and the environmental impact of improper refrigerant management.

- demonstrate an understanding of electrical circuits and controls.
- design an electrical control schematic and troubleshoot various electrical equipment.
- utilize freehand sketching and drafting skills for field applications.
- analyze manufacturer's data of equipment performance and economic factors related to heating, cooling, and refrigeration equipment.
- solve problems involving heating-cooling loads, heat transfer, air distribution, and psychometrics of air.
- explain the concepts of potable water and wastewater treatment systems and processes.

**Required Program**

	<b>Units</b>
MET 255 Mechanical Systems Maintenance .....	1.5
MET 256 Fundamentals of Instruments and Electricity.....	1.5
MET 257 Fundamentals of Workplace Success.....	1.5
MET 351 Basic Mechanical Systems .....	5
MET 352 Mechanical Systems Calculations .....	3
MET 361 Refrigeration Systems .....	3
MET 362 Refrigeration Systems Calculations .....	3
MET 363 Refrigerant Transition and Recovery Processes and Procedures .....	1.5
MET 364 Electrical Controls.....	3
<b>Total Units Required</b>	<b>23</b>

**Certificate of Achievement**

The Certificate of Achievement may be obtained by completion of the required program with grades of "C" or better.

**Suggested Semester Sequence****First Semester**

MET 255 Mechanical Systems Maintenance .....	1.5
MET 256 Fundamentals of Instruments and Electricity.....	1.5
MET 257 Fundamentals of Workplace Success.....	1.5
MET 351 Basic Mechanical Systems .....	5
MET 352 Mechanical Systems Calculations .....	3

**Second Semester**

MET 361 Refrigeration Systems .....	3
MET 362 Refrigeration Systems Calculations .....	3
MET 363 Refrigerant Transition and Recovery Processes and Procedures .....	1.5
MET 364 Electrical Controls.....	4

## Mechanical-Electrical Technology (MET)

### MET 255 Mechanical Systems Maintenance 1.5 Units

*Prerequisite:* None.

*Hours:* 27 hours LEC

This course introduces the student to basic maintenance concepts for basic mechanical systems. Units of instruction include coil maintenance, filters management, indoor air quality, lubrication, belts and drives, verifying operation, monitoring equipment, and maintenance contracts. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

### MET 256 Fundamentals of Instruments and Electricity 1.5 Units

*Prerequisite:* None.

*Hours:* 27 hours LEC

This course introduces the student to the fundamentals of electrical instruments and concepts required in commercial and industrial practice. Units of instruction include: fundamentals of electricity, ohms law, use of voltmeters, ammeters, ohmmeters, series and parallel circuits, wiring diagrams, and electro-magnetic theory. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

### MET 257 Fundamentals of Workplace Success 1.5 Units

*Prerequisite:* None.

*Hours:* 27 hours LEC

This course provides the student with basic workplace skills needed to enter the workforce as a machinery systems technician. Units of instruction include teamwork, ethics, diversity, communication skills, writing e-mail messages, Internet websites, conflict resolution, critical thinking, problem solving, conflict resolution, career management, sexual harassment, and drug and alcohol use. Components of this course will be offered online. Students will be required to have access to a computer and the Internet and have some familiarity with a computer.

### MET 294 Topics in Mechanical-Electrical Technology .5-4 Units

*Prerequisite:* None

*Hours:* 27 hours LEC; 54 hours LAB

This is a specialized course which has been developed in cooperation with industry to address emerging training needs. This course may be taken no more than three times for credit provided there is no duplication of topics.

### MET 295 Independent Studies in Mechanical-Electrical Technology 1-3 Units

*Prerequisite:* None

*Hours:* 54 hours LEC

See Independent Studies

### MET 351 Basic Mechanical Systems 5 Units

*Prerequisite:* None.

*Advisory:* MET 352 with a grade of "C" or better or concurrent enrollment in MET 352.

*Course Transferable to CSU*

*Hours:* 54 hours LEC; 108 hours LAB

This course is designed to introduce the student to the theoretical and practical applications of basic mechanical systems utilized in refrigeration, heating, cooling, steam power generation, photovoltaic and hot water solar systems, and the treatment of water for use in mechanical systems, drinking water, and wastewater treatment plants. Additional studies include fundamental laws of heat; theory of refrigeration and refrigerants; installation, operation, and testing of refrigeration units; and safe, efficient use of related hand, heat, and power tools. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

### MET 352 Mechanical Systems Calculations 3 Units

*Prerequisite:* None.

*Advisory:* MET 351 with a grade of "C" or better or concurrent enrollment in MET 351.

*General Education:* AA/AS Area II(b)

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This course focuses on building mathematical skills specific to the mechanical-electrical trades; problem solving using metric (SI) units and English and metric unit conversions; solution of word problems involving length, area, volume, weight, strength of materials, work, power, energy, and efficiencies; exponents, scientific notation, and roots; problem solving using graphs and tables; algebraic solutions to applied problems; freehand sketching employing multiview, isometric, and oblique drawing methods; and lettering and dimensioning. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

### MET 353 Water Treatment Plant Calculations 3 Units

*Prerequisite:* MET 352 with a grade of "C" or better

*Advisory:* MET 355 with a grade of "C" or better or concurrent enrollment in MET 355.

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This course focuses on mathematical problems involving English and metric units concerned with water treatment plant operation and maintenance. Emphasis will be placed on the basic mathematical skills required to prepare and take the Water Treatment Plant Operator Certification Examinations. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 354 Wastewater Treatment Plant Calculations 3 Units**

*Prerequisite:* MET 352 with a grade of "C" or better

*Advisory:* MET 356 with a grade of "C" or better or concurrent enrollment in MET 356.

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This course focuses on mathematical problems involving English and metric units concerned with wastewater treatment plant operation and maintenance. Emphasis will be placed on the basic mathematical skills required to prepare and take the Wastewater Treatment Plant Operator Certification Examinations. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 355 Water Treatment Plant Operation and Maintenance I 3 Units**

*Prerequisite:* None.

*Advisory:* MET 353 with a grade of "C" or better or concurrent enrollment in MET 353.

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This is the first of three courses (see MET 365 and MET 375) that focus on water resources and their preservation; water treatment systems and processes; system components; and related operation and safety practices. The emphasis of this course is safety and the effective operation and maintenance of a water treatment facility. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 356 Wastewater Treatment Plant Operation and Maintenance I 3 Units**

*Prerequisite:* None.

*Advisory:* MET 354 with a grade of "C" or better or concurrent enrollment in MET 354.

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This is the first of three courses (see MET 366 and MET 376) that focus on water resources and their preservation; wastewater treatment systems and processes; system components; and related operation and safety practices. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 361 Refrigeration Systems 3 Units**

*Prerequisite:* MET 351 with a grade of "C" or better

*Advisory:* MET 352 with a grade of "C" or better. Concurrent enrollment in MET 362, MET 363, and MET 364.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This is a course devoted to the study of residential and commercial refrigeration systems and equipment. Students learn about mechanical compression and absorption refrigeration devices; their operating characteristics, common applications and typical servicing procedures, and related safety practices. Hand tools, power tools, and test instruments are used by the student in lab to repair and service refrigeration devices. Students gain additional experience by analyzing system performance with pressure-enthalpy diagrams. Components of this course may be offered online. Students

may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 362 Refrigeration Systems Calculations 3 Units**

*Prerequisite:* MET 351 and 352 with grades of "C" or better

*Advisory:* MET 361, MET 363, and MET 364 with a grade of "C" or better or concurrent enrollment in MET 361, MET 363, and MET 364.

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This course focuses on mathematical problems involving English and metric (SI) units concerned with installation, operations, and maintenance of commercial and industrial refrigeration systems. Emphasis will be placed on basic heat transfer, loads, piping, equipment performance, and economic factors. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 363 Refrigerant Transition and Recovery Processes and Procedures 1.5 Units**

*Prerequisite:* MET 351 with a grade of "C" or better

*Advisory:* MET 361, MET 362, and MET 364 with a grade of "C" or better or concurrent enrollment in MET 361, MET 362, and MET 364.

*Course Transferable to CSU*

*Hours:* 27 hours LEC

This course focuses on the recovery and recycling of existing refrigerants, the transition to environmentally safe refrigerants, and the preparation for certification testing in refrigerant handling as mandated by the Clean Air Act, 40 CFR, part 82, subpart F and regulated by the Environmental Protection Agency (EPA). Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 364 Electrical Controls 3 Units**

*Prerequisite:* MET 256, 351, and 352 with grades of "C" or better

*Advisory:* MET 361, MET 362, and MET 363 with a grade of "C" or better or concurrent enrollment in MET 361, MET 362, and MET 363.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This course is an introduction to power and control circuits and devices used with refrigeration, heating, cooling, pumping, water treating, photovoltaic, and hot water solar heating mechanical systems. Units of instruction include a study of electron theory, magnetism, induction, alternating current, direct current, resistance, and capacitance. Practice using electrical meters and test instruments in laboratory classes along with related safety practices will also be covered. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 365 Water Treatment Plant Operation and Maintenance II 3 Units**

*Prerequisite:* MET 353 and 355 with grades of "C" or better  
*Course Transferable to CSU*

*Hours:* 54 hours LEC

This is the second of three courses (see MET 355 and MET 375) that focus on water resources and their preservation; water treatment systems and processes; system components; and related operation and safety practices. The emphasis of this course is on information needed by operators for the management and operation of water treatment facilities. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 366 Wastewater Treatment Plant Operation and Maintenance II 3 Units**

*Prerequisite:* MET 354 and 356 with grades of "C" or better  
*Course Transferable to CSU*

*Hours:* 54 hours LEC

This is the second of three courses (see MET 356 and MET 376) that focus on water resources and their preservation; wastewater treatment systems and processes; system components; related operation and safety practices. The emphasis of this course is on larger conventional wastewater treatment facilities. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 368 Heat Pump Operation and Maintenance 3 Units**

*Prerequisite:* MET 256, 351, and 352 with grades of "C" or better  
*Course Transferable to CSU*

*Hours:* 54 hours LEC

This course provides instruction in basic refrigeration and heat pump theory, cooling and heating cycles, defrost cycles, controls, supplemental heat, flow control devices, and heat load calculations. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 371 Heating and Power Machinery 3 Units**

*Prerequisite:* MET 255, 361, and 364 with grades of "C" or better  
*Advisory:* MET 372, MET 373, and MET 374 with a grade of "C" or better or concurrent enrollment in MET 372, MET 373, and MET 374.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This course provides instruction in warm air furnaces, hydronic heating, hot water solar systems, and steam and power plant systems. Instruction includes pumps, pumping head calculations, combustion principles, steam and hot water boilers, warm air furnaces, boiler safety and operating controls, and boiler emissions. Laboratory activities include operation, testing, maintenance, and troubleshooting of warm air furnaces and steam/hot water heating systems. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 372 Power Machinery, Heating and Air Conditioning Calculations 3 Units**

*Prerequisite:* MET 361 and 362 with grades of "C" or better  
*Advisory:* MET 371, MET 373, and MET 374 with a grade of "C" or better or concurrent enrollment in MET 371, MET 373, and MET 374.

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This course focuses on mathematical problems involving English and metric (SI) units concerned with installation, operation, and maintenance of power machinery, and heating and air conditioning systems. Emphasis will be placed on heat transfer, heating/cooling loads, pipe and pump sizing, steam and hot water system performance, psychrometrics, and duct sizing calculations. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 373 Piping, Electrical, and Sheet Metal Drafting 3 Units**

*Prerequisite:* MET 255, 361, and 364 with grades of "C" or better  
*Advisory:* MET 371, MET 372, and MET 374 with a grade of "C" or better or concurrent enrollment in MET 371, MET 372, and MET 374.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This course provides instruction in the design and construction of mechanical and piping systems. Units of instruction include mechanical and plumbing codes, basic sketching techniques, recognition of standard symbols, computer aided drawing applications, and construction terms and specifications. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 374 Automatic Control Systems I 3 Units**

*Prerequisite:* MET 361 and 364 with grades of "C" or better  
*Advisory:* MET 371, MET 372, and MET 373 with a grade of "C" or better or concurrent enrollment in MET 371, MET 372, and MET 373.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This is the first of two courses (see MET 384) that focus on the study of controls and devices used in heating, ventilation, air conditioning, pumping, water treatment, and manufacturing systems. Units of instruction include introduction to control theory, final controls devices, and pneumatic control systems. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 375 Water Treatment Plant Operation and Maintenance III 3 Units**

*Prerequisite:* MET 365 with a grade of "C" or better

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This is the third of three courses (see MET 355 and MET 365) that focus on water resources and their preservation; water treatment systems and processes; system components; and related operation and safety practices. The emphasis of this course is on small water treatment facilities. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 376 Wastewater Treatment Plant Operation and Maintenance III 3 Units**

*Prerequisite:* MET 366 with a grade of "C" or better

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This is the third of three courses (see MET 356 and MET 366) that focus on water resources and their preservation; wastewater treatment systems and processes; system components; related operation and safety practices. The emphasis of this course is on larger secondary and tertiary wastewater treatment facilities. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 378 Geothermal Heat Pump Operation and Maintenance 3 Units**

*Prerequisite:* MET 256, 351, and 352 with grades of "C" or better

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This course provides instruction in basic geothermal heat pump theory, cooling and heating cycles, load calculations, cost analysis, open and closed water loop systems, system diagnostics, and solar applications. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 381 Air Conditioning 3 Units**

*Prerequisite:* MET 371 and 372 with grades of "C" or better

*Advisory:* MET 382, MET 383, and MET 384 with a grade of "C" or better or concurrent enrollment in MET 382, MET 383, and MET 384.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This course provides instruction in the design, operation, and maintenance of commercial and industrial air conditioning systems. Instruction includes study of air distribution, variable air volume systems, refrigeration compressors, absorption air condition systems, helical-rotary and centrifugal water chillers, chilled water systems, thermal storage, cooling towers, photovoltaic and hot water solar systems, and energy management. Students will gain practical experience by operating commercial air conditioning systems. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 382 Air Conditioning Systems Calculations 3 Units**

*Prerequisite:* MET 372 with a grade of "C" or better

*Advisory:* MET 381, MET 383, and MET 384 with a grade of "C" or better or concurrent enrollment in MET 381, MET 383, and MET 384.

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This course provides an introduction to the use of computer applications in solving problems concerned with the design, installation, and operation of air conditioning systems. Units of instruction include calculating heating and cooling loads, piping, air distribution, equipment selection, psychometric and economic analysis. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 383 Instrumentation 3 Units**

*Prerequisite:* MET 361 and 364 with grades of "C" or better

*Advisory:* MET 381, MET 382, and MET 384 with a grade of "C" or better or concurrent enrollment in MET 381, MET 382, and MET 384.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This course provides instruction in the theory and practice of using instruments for testing and analyzing the operation of refrigerating, air conditioning, mechanical, electrical, and building systems. Units of instruction include a study of measurement principles including temperature, humidity, flow, light, sound, velocity, pressure, combustion emissions, air quality, voltage, level, force, and vibration. Laboratory activities will emphasize the practical applications of sensors and measuring instruments. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 384 Automatic Control Systems II 3 Units**

*Prerequisite:* MET 371 and 374 with grades of "C" or better

*Advisory:* MET 381, MET 382, and MET 383 with a grade of "C" or better or concurrent enrollment in MET 381, MET 382, and MET 383.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This is the second of two courses (see MET 374) that focus on the study of controls and devices used in heating, ventilation, air conditioning, pumping, water treatment, and manufacturing systems. Units of instruction include electronic and direct digital controls, networks, interoperable systems, and programming of controllers. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 391 Mechanical Systems Commissioning 3 Units**

*Prerequisite:* MET 381, 383, and 384 with grades of "C" or better  
*Advisory:* MET 392 and MET 396 with a grade of "C" or better or concurrent enrollment in MET 392 and MET 396.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This course focuses on the techniques and practices of commissioning controls and mechanical systems that are used in heating, ventilation, air conditioning, pumping, renewable and sustainable energy, and water treatment. Units of instruction include energy conservation; developing and implementing a comprehensive commissioning plan; inspection and testing of control systems, mechanical equipment, field devices and user interfaces to ensure that they are installed, programmed, and operated precisely as the design intent. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 392 Energy Management and Efficiency for HVAC Mechanical Systems 3 Units**

*Prerequisite:* MET 381, 383, and 384 with grades of "C" or better  
*Advisory:* MET 391 and MET 396 with a grade of "C" or better or concurrent enrollment in MET 391 and MET 396.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

The course focuses on the theory, techniques, and practices of optimizing the energy efficiency of mechanical systems that are used in heating, ventilating, cooling, pumping, and water treatment. Students will review the concepts and principles of the design of commercial heating, ventilating, and air conditioning (HVAC) systems and direct digital controls (DDC). This course will introduce the economics of operating electrical and mechanical equipment, methods of acquiring HVAC equipment performance data through the use of portable data loggers and DDC control systems, and using that data to improve operations and reduce energy consumption. Discussions will include current industry practices for energy conservation, utility rate schedules and rebate programs, overview of California Energy Code and LEED Leadership in Energy and Environmental Design, and the U. S. Green Building Council rating system. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 393 Commercial Building Energy Audits and Calculations 3 Units**

*Prerequisite:* MET 392 with a grade of "C" or better  
*Advisory:* MET 391 and MET 396 with a grade of "C" or better or concurrent enrollment in MET 391 and MET 396.

*Course Transferable to CSU*

*Hours:* 36 hours LEC; 54 hours LAB

This course focuses on the theory, techniques and practices of analyzing all aspects of large commercial building operations and correlating a building envelope's interaction with the mechanical systems. Students will perform a detailed energy audit of a state-of-the-art commercial building design using energy modeling simulation software and develop energy conservation strategies, such as thermal storage, that can be applied to heating, cooling, and ventilating equipment to reduce utility bills. Students will apply supporting analytical data to develop operations and maintenance changes designed to improve energy efficiency and reduce

operating cost. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 395 Water Treatment for Heating and Air Conditioning Equipment 3 Units**

*Prerequisite:* MET 381 and 383 with grades of "C" or better  
*Advisory:* MET 391, and MET 396 with a grade of "C" or better or concurrent enrollment in MET 391, and MET 396.

*Course Transferable to CSU*

*Hours:* 54 hours LEC

This course focuses on basic mechanical system water sides theories of corrosion, scaling, and algae-slime growth-corrosion inhibition, chemicals and feed-bleed-blowdown systems; scaling inhibition, chemicals, and feed-blowdown systems; algae inhibition and chemicals; testing methods, kits, and instruments; and water quality standards. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 396 Air and Water Balance of Mechanical Equipment 3 Units**

*Prerequisite:* MET 381, 383, and 384 with grades of "C" or better  
*Advisory:* MET 391 and MET 392 with a grade of "C" or better or concurrent enrollment in MET 391 and MET 392.

*Course Transferable to CSU*

*Hours:* 36 hours LEC

This course focuses on air and water flow theory; air and water systems and components; air flow measuring instruments, their calibration, and use; and typical water flow balance work. Components of this course may be offered online. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

**MET 495 Independent Studies in Mechanical-Electrical Technology 1-3 Units**

*Prerequisite:* None

*Course Transferable to CSU*

*Hours:* 54 hours LAB

See Independent Studies

**MET 499 Experimental Offering in Mechanical-Electrical Technology .5-4 Units**

*Prerequisite:* None

*Course Transferable to CSU*

*Hours:* 54 hours LEC; 54 hours LAB

See Experimental Offering