GAVILAN COLLEGE
5055 Santa Teresa Blvd
Gilroy, CA 95023

Course Outline

COURSE: HVAC 206 DIVISION: 50 ALSO LISTED AS:

TERM EFFECTIVE: Fall 2018 CURRICULUM APPROVAL DATE: 03/12/2018

SHORT TITLE: HVAC Controls

LONG TITLE: HVAC Controls

Units	Number of Weeks		Contact Hours/Week		Total Contact Hours
4	18	Lecture:	3	Lecture:	54
		Lab:	3	Lab:	54
		Other:	0	Other:	0
		Total:	6	Total:	108

COURSE DESCRIPTION:

Students will study theory, application, and operation of Heating, Ventilating, and Air Conditioning (HVAC) control systems; including electric, pneumatic, solid state, and digital control systems. They will also study Energy Management Systems (EMS), Building Management Systems (BMS), building applications, and green technology; including fire/smoke, lighting, and heating and ventilation controls. PREREQUISITE: HVAC 201 and HVAC 202 with a grade of "C" or better. ADVISORY: Eligible for MATH 430.

PREREQUISITES:

Completion of HVAC 201, as UG, with a grade of C or better.
AND Completion of HVAC 202, as UG, with a grade of C or better.

COREQUISITES:

CREDIT STATUS: D - Credit - Degree Applicable

GRADING MODES

L - Standard Letter Grade
P - Pass/No Pass

REPEATABILITY: N - Course may not be repeated

SCHEDULE TYPES:

02 - Lecture and/or discussion
03 - Lecture/Laboratory
04 - Laboratory/Studio/Activity
04A - Laboratory - LEH 0.65

STUDENT LEARNING OUTCOMES:

1. Utilizing professional control terminology, define control and control systems.

Measure of assessment: Exam

Year assessed, or planned year of assessment: 2019

Semester: Spring

Institution Outcome Map

2. Cognition:

2.1 Students will think logically and critically in solving problems; explaining their conclusions; and evaluating, supporting, or critiquing the thinking of others.

2.2 Analysis and Synthesis: Students will understand and build upon complex issues and discover the connections and correlations among ideas to advance toward a valid independent conclusion.

2.3 Problem Solving: Students will identify and analyze real or potential problems and develop, evaluate, and test possible solutions, using the scientific method where appropriate.

2.4 Creative Thinking: Students will formulate ideas and concepts in addition to using those of others.

2.5 Quantitative Reasoning: Students will use college-level mathematical concepts and methods to understand, analyze, and explain issues in quantitative terms.

2.6 Transfer of Knowledge and Skills to a New Context: Students will apply their knowledge and skills to new and varied situations.

2. Describe and identify pneumatic control systems, including air compressor station and control devices.

Measure of assessment: Exam, Demonstration, Homework

Year assessed, or planned year of assessment: 2019

Semester: Spring

Institution Outcome Map

1. Communication:

1.1 Students will communicate effectively in many different situations, involving diverse people and viewpoints.

1.2 Speaking: Students will speak in an understandable and organized fashion to explain their ideas, express their feelings, or support a conclusion.

1.3 Listening: Students will listen actively and respectfully to analyze the substance of others' comments.

1.4 Reading: Students will read effectively and analytically and will comprehend at the college level.

1.5 Writing: Students will write in an understandable and organized fashion to explain their ideas, express their feelings, or support a conclusion.

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2.6 Transfer of Knowledge and Skills to a New Context: Students will apply their knowledge and skills to new and varied situations.

3. Describe and demonstrate building automation systems, control devices, inputs/outputs, networking, installation, wiring, and testing.

Measure of assessment: Exam, Demonstration, Homework

Year assessed, or planned year of assessment: 2019

Semester: Spring

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2.6 Transfer of Knowledge and Skills to a New Context: Students will apply their knowledge and skills to new and varied situations.

4. Social Interaction:

4.1 Students will interact with individuals and within groups with integrity and awareness of others' opinions, feelings and values.

4.2 Teamwork: Students will participate effectively in teams, committees, task forces, and in other group efforts to make decisions and seek consensus.

4.3 Effective Citizenship: Students will take personal responsibility for being informed, ethical and active citizens of their community, their nation, and their world.

4. Set up and design the parameters for a Building Management System (BMS).

Measure of assessment: Project, Homework, Demonstration

Year assessed, or planned year of assessment: 2019

Semester: Spring

Institution Outcome Map

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2.2 Analysis and Synthesis: Students will understand and build upon complex issues and discover the connections and correlations among ideas to advance toward a valid independent conclusion.

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CONTENT, STUDENT PERFORMANCE OBJECTIVES, OUT-OF-CLASS ASSIGNMENTS

Curriculum Approval Date: 03/12/2018

LECTURE CONTENT:

5 Hours

Content: Control Theory and Terminology - Define Control, Purposes of Control, Terminology

Student Performance Objectives: Define control and state the purposes of control. Utilize appropriate control terminology.

5 Hours

Content: Control Systems - Electric/Electronic, Pneumatic, Automatic/System Powered

Student Performance Objectives: Name three types of automatic controls. Discuss the various types of control systems. List what makes up a control system.

5 Hours

Content: Pneumatic Control System and Control Devices - Air Compressor Station, Auxiliary Equipment; Thermostats, Transmitters, Receivers; Actuators, Dampers and Valves

Student Performance Objectives: Recognize advanced control terminology. Describe pneumatic control circuits. Discuss a control loop. Explain the pneumatic control system and the control devices used with this system. State the advantages of pneumatic controls.

5 Hours

Content: Electric Control System - Different Types and Power Sources; Protection, Over-current, Relays, Disconnects

Student Performance Objectives: State the purpose of electric controls. Distinguish between mechanical and electrical controls. Explain the electric control system and the control devices used with this system.

5 Hours

Content: Electronic Control System - Different Types and Power Sources; Semi-conductor, Electronic and Integrated Circuits

Student Performance Objectives: Describe electronic control circuits. State the major components of an electronic control system. Explain the electronic control system and the control devices used with this system.

11 Hours

Content: Building Automated Systems: Energy Management Systems (EMS) - Central Supervisory Control, Digital Control and Network Systems; Interfaces; System Input/Output Sensors; Networking Fundamentals, Installation, Wiring and Testing; System Architecture of the New Johnson Controls "Metasys" Building/Energy Management System (B/EMS); Performance of the Model Driven Architecture (MDA) Buildings Systems Through the B/EMS; Temperatures, Airflows and Equipment Performance Through the B/EMS; Trend Data Accumulated by the B/EMS to Estimate Overall Building Energy Use; Performance of the Demand Control Ventilation Systems for Overall Occupant Comfort and Health; Generation of Energy "Dashboard" Information for Public Display and Education

Student Performance Objectives: Define Energy Management Systems (EMS) and discuss how they are built. Discuss the different types of controls. State the purpose of an EMS. Describe the function of sensors. Discuss networking fundamentals, installation, wiring and testing. Explain how to assess B/EMS energy use and/or savings. Discuss the Johnson Controls "Metasys" Building/Energy Management System, including its function and efficiency. State the purpose of an Energy "Dashboard".

5 Hours

Content: Direct Digital Control Strategies - Open/Closed Loop Circuits, Direct Digital Control Algorithms, Tuning Proportional Integral (PI) and Proportional Integral Derivative (PID) Control Loops

Student Performance Objectives: Explain the difference between open and closed loop circuits. Discuss the major advantages a Direct Digital Control (DDC) system has over a traditional control system.

5 Hours

Content: Utilities and Surveys - Utility Rates; Consumption, Demand and Power Factor; Summer/Winter Time Rates; Time-of-day/Peak Time Rates

Student Performance Objectives: Discuss the importance of understanding utility rates. Explain how consumption and demand are calculated and discuss the importance of knowing this information. Describe the benefits of knowing utility rates, consumption, and demand when working with HVAC control systems.

5 Hours

Content: Building Automation Retrofit of Existing Systems - Types of Ventilation Systems; High/Low Velocity, Perimeter; Variable Air Volume (VAV), Terminal Box Control; Boiler/Chiller Applications

Student Performance Objectives: Describe the different types of ventilation systems. Explain the concept of variable air volume (VAV). Explain the differences between a VAV systems and other systems.

2 Hours

Final

LAB CONTENT:

5 Hours

Content: Control Theory and Terminology - Types of Controls, Terminology

Student Performance Objectives: Identify and describe the different types of controls. Utilize appropriate control terminology.

5 Hours

Content: Control Systems - Electric/Electronic, Pneumatic, Automatic/System Powered

Student Performance Objectives: Discuss and identify the various types of control systems. Explain some of the major advantages a DDC control system has over a traditional control system.

5 Hours

Content: Pneumatic Control System and Control Devices - Air Compressor Station, Auxiliary Equipment; Thermostats, Transmitters, Receivers; Actuators, Dampers and Valves

Student Performance Objectives: Utilize advanced control terminology. Demonstrate control applications. Explain how direct digital control systems work. Discuss and demonstrate basic troubleshooting for pneumatic control systems. Describe and demonstrate typical preventive maintenance procedures used in pneumatic control systems.

5 Hours

Content: Electric Control System - Troubleshooting, Calibration and Adjustment

Student Performance Objectives: Discuss and demonstrate basic troubleshooting for electric control systems. Describe and demonstrate typical preventive maintenance procedures used in electric control systems.

5 Hours

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Student Performance Objectives: Discuss and demonstrate basic troubleshooting for electronic control systems. Describe and demonstrate typical preventive maintenance procedures used in electronic control systems.

11 Hours

Content: Building Automated Systems: Energy Management Systems (EMS) - Central Supervisory Control, Digital Control and Network Systems; Interfaces; System Input/Output Sensors; Networking Fundamentals, Installation, Wiring and Testing; System Architecture of the New Johnson Controls "Metasys" Building/Energy Management System (B/EMS); Performance of the Model Driven Architecture (MDA) Buildings Systems Through the B/EMS; Temperatures, Airflows and Equipment Performance Through the B/EMS; Trend Data Accumulated by the B/EMS to Estimate Overall Building Energy Use; Performance of the Demand Control Ventilation Systems for Overall Occupant Comfort and Health; Generation of Energy "Dashboard" Information for Public Display and Education

Student Performance Objectives: Describe and demonstrate how to build the controls for an automation system. Troubleshoot a systems input/output sensors. Describe and demonstrate networking fundamentals, installation, wiring and testing. Describe and demonstrate how to determine overall building energy use. Describe and demonstrate the performance of the demand control ventilation systems for overall occupant comfort and health. Complete the service technician call scenarios for a variety of Building Automated Systems.

5 Hours

Content: Direct Digital Control Strategies - Open/Closed Loop Circuits, Direct Digital Control Algorithms, Tuning Proportional Integral (PI) and Proportional Integral Derivative (PID) Control Loops

Student Performance Objectives: Identify and describe the difference between an open-loop and a closed-loop control configuration in a Direct Digital Control (DDC) system. Describe the difference between the analog and digital signals in a DDC control system. Troubleshoot DDC systems.

5 Hours

Content: Utilities and Surveys - Utility Rates; Consumption, Demand and Power Factor; Summer/Winter Time Rates; Time-of-day/Peak Time Rates

Student Performance Objectives: Demonstrate how to calculate utility rates, consumption and demand. Troubleshoot systems that are taxing demand and power.

5 Hours

Content: Building Automation Retrofit of Existing Systems - Types of Ventilation Systems; High/Low Velocity, Perimeter; Variable Air Volume (VAV), Terminal Box Control; Boiler/Chiller Applications

Student Performance Objectives: Identify the various types of ventilation systems. List, identify and explain the four common configurations of VAV boxes or terminal units. Explain and troubleshoot the operation of a chilled-water Variable Air Volume (VAV) system.

2 Hours

Final

METHODS OF INSTRUCTION:

Lecture, discussion, multi-media presentation, demonstration, guided practice.

OUT OF CLASS ASSIGNMENTS:

Required Outside Hours: 10

Assignment Description: Read corresponding information in textbook and/or related handouts. Complete Review Questions. Study for quizzes/examinations. Homework: Complete Workbook Exercises related to topics. Homework Example: Complete Terminology Worksheet.

Required Outside Hours: 10

Assignment Description: Read corresponding information in textbook and/or related handouts. Complete Review Questions. Study for quizzes/examinations. Homework: Complete Workbook Exercises related to topics. Homework: Perform various troubleshooting exercises related to control systems.

Required Outside Hours: 10

Assignment Description: Read corresponding information in textbook and/or related handouts. Complete Review Questions. Study for quizzes/examinations. Homework: Complete Workbook Exercises related to topics. Homework Example: Complete Terminology Worksheet on Advanced Control Terminology.

Required Outside Hours: 10

Assignment Description: Read corresponding information in textbook and/or related handouts. Complete Review Questions. Study for quizzes/examinations. Homework: Complete Workbook Exercises related to topics. Homework: Perform various troubleshooting exercises related to electric control systems.

Required Outside Hours: 10

Assignment Description: Read corresponding information in textbook and/or related handouts. Complete Review Questions. Study for quizzes/examinations. Homework: Complete Workbook Exercises related to topics. Homework: Perform various troubleshooting exercises related to electronic control systems.

Required Outside Hours: 22

Assignment Description: Read corresponding information in textbook and/or related handouts. Complete Review Questions. Study for quizzes/examinations. Homework: Complete Workbook Exercises related to topics. Project: Program a control system for a commercial building, including the occupied and unoccupied settings.

Required Outside Hours: 10

Assignment Description: Read corresponding information in textbook and/or related handouts. Complete Review Questions. Study for quizzes/examinations. Homework: Complete Workbook Exercises related to topics. Homework: Perform various troubleshooting exercises related to open/closed loop circuits.

Required Outside Hours: 10

Assignment Description: Read corresponding information in textbook and/or related handouts. Complete Review Questions. Study for quizzes/examinations. Homework: Complete Workbook Exercises related to topics. Homework: Perform various exercises related to utility rates, consumption, and demand.

Required Outside Hours: 10

Assignment Description: Read corresponding information in textbook and/or related handouts. Complete Review Questions. Study for quizzes/examinations. Homework: Complete Workbook Exercises related to topics. Homework: Perform various troubleshooting exercises related to retrofitting of existing systems.

METHODS OF EVALUATION:

Writing assignments
Percent of total grade: 20.00 %
Homework, Lab Reports
Problem-solving assignments
Percent of total grade: 20.00 %
Lab Projects
Skill demonstrations
Percent of total grade: 20.00 %
Lab Projects/Troubleshooting
Objective examinations
Percent of total grade: 40.00 %
Quizzes/Examinations

REPRESENTATIVE TEXTBOOKS:

Required Representative Textbooks

John A. Tomczyk, Eugene Silberstein, William C. Whitman, William M. Johnson. Refrigeration and Air Conditioning Technology, 8th Edition. Boston, MA: Cengage Learning,2017.

ISBN: 978-1-305-57829-6

Reading Level of Text, Grade: 12th Verified by: MS Word

Tomczyk, Silberstein, Whitman, Johnson. Lab Manual for Refrigeration and Air Conditioning Technology, 8th Edition. Boston, MA: Cengage Learning,2017.

ISBN: 978-1305578708

Reading Level of Text, Grade: 12th Verified by: MS Word

ARTICULATION and CERTIFICATE INFORMATION

Associate Degree:
CSU GE:
IGETC:
CSU TRANSFER:
Not Transferable
UC TRANSFER:
Not Transferable

SUPPLEMENTAL DATA:
Basic Skills: N
Classification: Y
Noncredit Category: Y
Cooperative Education:
Program Status: 1 Program Applicable
Special Class Status: N
CAN:
CAN Sequence:
CSU Crosswalk Course Department:
CSU Crosswalk Course Number:
Prior to College Level: Y
Non Credit Enhanced Funding: N
Funding Agency Code: Y

In-Service: N
Occupational Course: C
Maximum Hours:
Minimum Hours:
Course Control Number:
Sports/Physical Education Course: N
Taxonomy of Program: 094600