Course Acronym:	ACR
Course Number:	61
Descriptive Title:	Fundamentals of Automation Systems
Division:	Industry and Technology
Department:	Air Conditioning and Refrigeration
Course Disciplines:	Air Conditioning and Refrigeration, Heating
Catalog Description:	This course is an introduction to the fundamentals of automation, commissioning, re-commissioning, retro-commissioning, installation, service and troubleshooting of mechanical, electrical, and Direct Digital Control (DDC) systems for the Heating, Ventilation, Air-Conditioning, and Refrigeration (HVACR) industry. This course includes a review of automation system communication protocols and unit supervisory level programming.
Prerequisite:	
Co-requisite:	
Recommended Preparation:	Air Conditioning and Refrigeration 31 and Air Conditioning and Refrigeration 21
Enrollment Limitation:	
Hours Lecture (per week):	3
Hours Laboratory (per week):	0
Outside Study Hours:	6
Total Course Hours:	54
Course Units:	3
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	2/17/2015
Transfer UC:	No
Effective Date:	
General Education: ECC	
Term:	
Other:	
CSU GE:	

Term:	
Other:	
IGETC:	
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Multi-site Control System** After reading the textbook and participating in class discussions, students will apply their knowledge of automation systems to propose, develop, plan, justify, and create component, architecture, and design document to support a multi-site control system. This system will include lighting, air-conditioning, refrigeration, security and refrigeration systems. **SLO #2 BACnet and LON Communication Networks** After completing this course students will apply their knowledge to identify, evaluate, and troubleshoot BACnet and LON communication networks. Student identification will include the ability to differentiate the communication protocols and their architecture. The evaluation of the communicating networks will include the ability to evaluate network stability, structure, and configuration. Network troubleshooting skills will include the basic ability to identify network communication protocol signatures and monogramming characteristics. **SLO #3 Commissioning Skills** Students completing course readings and active participation in classroom activates will have ability to apply their knowledge in effective system commissioning. Student commissioning skills will include the ability to evaluate system component operation, calibration, and integration.v Commissioning skills will also include the ability to interpret, evaluate and comply with commissioning documentation requirements.
Course Objectives:	1. Identify key components of automation systems. 2. Demonstrate understanding of automation hierarchy, integration, and interoperability. 3. Develop and implement commissioning plans for new and existing equipment. 4. Develop test procedures for data collection and analysis. 5. Demonstrate understanding, differentiate, evaluate, and identification of communication protocols. 6. Demonstrate the application of smart system components and design. 7. Demonstrate understanding of interconnection of automation system controller types. 8. Analyze controller network architecture, setup, and configuration.
Major Topics:	**I. Microprocessor and Microcontroller (4 hours, Lecture)** A. Application B. Architecture C. Structure D. Installation E. Service F. Troubleshooting

II. Automation (12 hours, Lecture)

    A.   Components
    B.   Hierarchy
    C.   Integration
    D.   Interoperability
    E.   Troubleshooting
    F.   Service
    G.   Installation

III. System Configuration (4 hours, Lecture)

    A.   Server based
    B.   Legacy
    C.   Multi-site

IV. Commissioning (12 hours, Lecture)

    A.   Test procedures
    B.   Data collection
    C.   Data analysis
    D.   Re-commissioning
    E.   Retro-commissioning

V. System Components (4 hours, Lecture)

    A.   Operator Interface
    B.   System control
    C.   Unit control

VI. Communication (12 hours, Lecture)

    A.   Protocols
    B.   Integration
    C.   Interoperability
    D.   Structure
    E.   Differentiation
    F.   Network structure

VII. Smart Systems (6 hours, Lecture)

    A.   Components
    B.   Architecture
    C.   Design
    D.   Programming concepts

Total Lecture Hours:	54
Total Laboratory Hours:	0
Total Hours:	54

Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	Develop a three-page report that links automation system architecture, structure, and hierarchy with system efficiency and performance. Submit report to the instructor.
Critical Thinking Assignment 1:	In a minimum two-page document, illustrate and explain system integration and the benefits to the customer. This document will include 5 key components: the justification and requirements for system integration, the cost, reliability and life cycle advantage of integration, system sustainability, the advantages and disadvantages of competing communication protocols, and how integration relates to energy optimization and efficiency. Submit document to the instructor.
Critical Thinking Assignment 2:	Given a communication system model, develop a three-page commissioning, test and evaluation document that demonstrates a clear understanding of the commissioning process and how that process enhances system operational, design, and energy efficiency. Submit document to the instructor.
Other Evaluation Methods:	Homework Problems, Multiple Choice, Presentation, Quizzes, Written Homework
Instructional Methods:	Discussion, Field trips, Group Activities, Guest Speakers, Lecture, Multimedia presentations, Role play/simulation
If other:	Internet Presentation/Resources
Work Outside of Class:	Answer questions, Journal (done on a continuing basis throughout the semester), Observation of or participation in an activity related to course content (such as theatre event, museum, concert, debate, meeting), Problem solving activity, Required reading, Study, Written work (such as essay/composition/report/analysis/research)
If Other:	
Up-To-Date Representative Textbooks:	Andrew Althouse, Carl Turnquist, A.F. Bracciano, D. C. Bracciano and G. M. Bracciano. Modern Refrigeration and Air Conditioning. 22nd edition. Goodheart Willcox. 2025 Textbook is now available in printed text and digital format.
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	
Requisite:	
Category:	
Requisite course(s): List both prerequisites and corequisites in this box.	
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	

Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	Air Conditioning and Refrigeration-21 Air Conditioning and Refrigeration-31
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Basic HVACR system knowledge.** ACR 21 - Complete a safety test with 100% accuracy. ACR 21 - Define air conditioning and methods of achieving it. ACR 21 - Diagnose operating and safety controls and switches. ACR 21 - Demonstrate knowledge of system refrigeration components and refrigerant flow. ACR 31 - Complete a safety test with 100% accuracy. ACR 31 - Install, test and troubleshoot single and multi-function electronic controls. ACR 31 - Identify and describe the operation of (VAV) controls and systems. ACR 31 - Compare and contrast the efficiency and performance of various types of single speed motors with variable speed motors. ACR 31 - Identify and describe electronic components and functions
Requisite Skill:	
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Timothy Muckey
Date:	10/24/2013
Original Board Approval Date:	02/17/2015
Last Reviewed and/or Revised by:	Vincent Bethel
Date:	04/01/2024

Last Board Approval Date:	06/17/2024 effective FALL 2025