Online Certificate in Safety Instrumented Systems

Description

The Online Certificate in Safety Instrumented Systems (SIS) is an instructor-led online program consisting of four modules which cover the different aspects of the SIS life cycle in the standard ISA/IEC-61511. The program covers engineering requirements, design, analysis, evaluation, and maintenance of the systems. Besides learning the technical standards, students will gain practical insight from the instructor's 16 years of experience in industry. The instructor is the Director-elect (2022-2023) for ISA Safety and Security Division.

The course material, when combined with the required industry experience, is designed to aid students to successfully pass the Certified Functional Safety Expert (CFSE/CFSP) certification examinations. The course material will help students to enter into the field of instrumented safety systems or to better perform their work if they are already in the field.

Participants in this training program will learn to:

- Differentiate between process control and safety control
- Understand the complete SIS life cycle as outlined in ISA/IEC 61511
- Select safety integrity levels
- Evaluate a safety instrumented system
- Design, test and install a safety instrumented system
- Maintain and secure a safety instrumented system

Who Should Enroll

- Engineers and technicians who are responsible for designing, installing, operating, and/or maintaining safety instrumented systems
- Process safety engineers
- Plant risk analysts
- Operators and maintenance technicians
- Anyone preparing for the Certified Functional Safety Expert (CFSE/CFSP) certification examinations

Reference Book

The class will use Paul Gruhn & Simon Lucchini's book ***Safety Instrumented Systems – A Life-Cycle Approach***. The book will be provided to all students at no additional cost.

Certificate Requirements

The certificate is awarded after the successful completion of the four modules. This represents approximately 200 hours of training, which includes online sessions, assignments, and exam preparation. The participants must attain a minimum of 70 percent for each module and an aggregate average of at least 75 percent in the program.

Prerequisites

Some experience is required in instrumentation used in refineries and process plants (process transmitters, control/shutdown valves, distributed control systems (DCS), PLCs, relays, and pneumatic systems) and in process hazards analysis (PHA) and risk assessment. Basic algebra skills are also required.

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Instructor

Qing Cai is a control system engineer (PE) and a Certified Functional Safety Expert (CFSE). He has 16 years of experience in functional safety engineering and operation and control, instrument and electrical engineering in the chemical industry.

Cai is the Director-elect (2022-2023) of International Society of Automation (ISA)'s Safety and Security Division. He is currently the Regional Principal Functional Safety Engineer for Covestro, in Baytown, Texas. He leads initiatives for improvement at the plant, which includes automating Safety Requirement Specification (SRS), starting failure data statistics, managing prior use process. He is a functional safety trainer.

Prior to his work at Covestro, Cai held a number of functional safety and process control positions at different Bayer plants around the world. He was also the Functional Safety Trainer for the Bayer CropScience plant in Villefranche-sur-Saone France and for those in Muskegon, Michigan; Kansas City, Missouri; Hangzhou, China; and Vapi, India.

Cai has a Master of Business Administration from the University of Houston in Clear Lake and a Bachelor of Automation from the East China University of Science and Technology.

How You Will Learn

This online course has four modules of six weekly sessions each. The sessions meet at 6 pm U.S. Central Time for a 1-hour lecture plus a 30-minute Q&A session. All sessions are recorded so those who miss them or want to watch again can view the recordings. Sessions have a weekly reading and a weekly quiz, a class project, and some homework assignments. There is a test at the end of each module on what was covered in the module and a final certificate exam at the end of the course. In Module 4, students will be required to create an SIS design project from the information that the instructor provides. For this final project, students will combine the material of the previous modules to design an SIS system at the system level and provide the associated system level documents.

COURSE CONTENT

Module 1 – Introduction to SIS

0. Session 0 – a Get-to-know-you session. No instructional material will be given.

1. Session 1: Introduction

    a. What is a Safety Instrumented System (SIS)?
    b. Industry Guidelines, Standards, and Regulations related to SIS
    c. SIS & Functional Safety
    d. Industry Considerations Regarding SIS

2. Session 2: SIS Design Life Cycle, Part 1

    a. Hindsight/Foresight
    b. Findings of the UK Health & Safety Executive (HSE)
    c. ISA/IEC 61511 Safety Life Cycle

   d. Design Life Cycle
      i. Management
      ii. Verification
      iii. Hazards & Risk Analysis
      iv. Allocation of Safety Functions to Protective Layers
      v. Developing the Safety Requirements Specification

3. Session 3: SIS Design Life Cycle, Part 2

   a. Design Life Cycle
      i. SIS Design and Engineering
      ii. Installation & Commissioning
      iii. Validation
      iv. Operations and Maintenance
      v. Modifications
      vi. Decommissioning

4. Session 4: Project Management

   a. Functional Safety Plan
   b. Real World Complications
   c. Aligning the Functional Safety Plan with Project Execution
   d. Key Elements of a Functional Safety Plan

5. Session 5: Process Control vs Safety Controls

   a. Process Control vs Safety Controls Defined
   b. Differences between Process Control vs Safety Controls
   c. Low-demand, high-demand, and continuous-demand Safety Functions
   d. Separation of Process Control vs Safety Controls
   e. Integration of Process Control vs Safety Controls
   f. Common Cause and Systematic Failure Modes
   g. Diversification
   h. Practical Application

6. Session 6: Protection Layers

   a. Protection Layers
   b. Independent Protection Layers (IPL)
   c. Mitigation Layers
   d. Module Review

MODULE 1 EXAM

Module 2 – SIS Design

1. Session 1: Safety Requirements Specification (SRS)

    a. Need to Specify vs Desire to Design & Build
    b. Specification, Requirements, & Incidents
    c. Developing the SRS & ISA/IEC 61511
    d. Practical Application

2. Session 2: Selecting Safety Integrity Levels (SIL), Part 1

    a. Who is Responsible?
    b. Which Technique?
    c. Evaluating Risk
    d. Safety Integrity Levels (SIL)
    e. Practical Application

3. Session 3: Selecting Safety Integrity Levels (SIL), Part 2

    a. Safety Layer Matrix
    b. Risk Graph
    c. Layer of Protection Analysis (LOPA)
    d. Practical Application

4. Session 4: Choosing a Technology

    a. Pneumatic Systems
    b. Relay Systems
    c. Solid State Systems
    d. Microprocessor Based Systems
    e. Certified vs. Prior Use
    f. Practical Application

5. Session 5: Initial System Evaluation, Part 1

    a. Design Considerations
    b. Where to get failure rate data
    c. Failure modes
    d. Modelling Methods
    e. Basic Probability of Failure on Demand Average (PFDavg) Formulas
    f. PFDavg Homework Assignment
    g. Practical Application

6. Session 6: Initial System Evaluation, Part 2

    a. Analysis of a Relay System
    b. Analysis of other Logic Systems
    c. System Analysis Including Field Devices
    d. Homework Assignment
    e. Practical Application
    f. Module Test Review

MODULE 2 EXAM

Module 3 – Engineering and Testing

1. Session 1: System Evaluation Advanced Topics

    a. Imperfect Manual Testing
    b. Impact of Bypassing
    c. Systematic Failures
    d. Fault tolerance Requirements
    e. Abnormal Situation Management
    f. Practical Application

2. Session 2: Field Devices

    a. Reliability and Systematic Capability
    b. Sensors
    c. Final Elements
    d. Practical Application

3. Session 3: Engineering a System

    a. Project Schedule verses out of Sequence Design
    b. Design Documents
    c. Architecture Drawing
    d. Input / Output Signal Interface
    e. Operator SIS interface
    f. Practical Application

4. Session 4: Software

    a. Systematic approach to software development
    b. Software Safety Requirement Specification
    c. Why and How of Software Development

   d. KISS principle
   e. Practical Application

5. Session 5: System Testing

   a. Testing Philosophy
   b. Setting up a Test Plan
   c. FAT/SAT
   d. Proof Test Procedures
   e. Partial Stroke Testing
   f. Homework Assignment: Proof test Procedure
   g. Practical Application

6. Session 6: Installing a System

   a. Construction Requirements
   b. Reliability & Installation
   c. Commissioning
   d. Validation
   e. Pre-startup Safety Review (PSSR)
   f. Practical Application
   g. Module Test Review

MODULE 3 EXAM

Module 4 – Operations and Maintenance

1. Session 1: Case Study

   a. What Is a Case Study?
   b. Making Sense of the Safety Life Cycle
   c. Defining Safety System Requirements
   d. Designing the Safety System
   e. Homework Assignment: Student SIS Project (due before the last class in this module)
   f. Practical Application

2. Session 2: Operation & Maintenance

   a. Documentation for Operations & Maintenance Phase
   b. Commissioning & Startup
   c. System Testing, Analysis, and Maintenance
   d. Management Systems

3. Session 3: Management of Change (MOC)

    a. Why do We Manage Change?
    b. MOC of Software Programs
    c. Management of Equipment and Software Versions
    d. Practical Application

4. Session 4: Cybersecurity

    a. ISA/IEC 62443
    b. Data flow analysis
    c. Logic Solver & HMI
    d. Field instruments
    e. SIS security assessment
    f. Vulnerability assessment of existing SIS systems
    g. Practical Application

5. Session 5: SIS Checklists

    a. Why Use Checklist?
    b. Checklist for Each Phase of the Safety Life Cycle
    c. Homework Review

6. Session 6: Certificate Course Test Review

FINAL EXAM and DESIGN PROJECT (Case Study)