Operating Plant and Systems Professionals

Inc. ‘Your Increased Profitability is Our Bottom Line’

FIT Course Offerings

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FIT, Inc. offers training for all levels of skill and position in many of the technical areas of a production facility.

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Engineering

FIT-E01. Industrial Energy Management in the 21st Century

Instructor – Dr. Alan Rossiter, PhD, P.E., C. Eng.
Who Should Attend – The course is aimed at energy managers, energy coordinators, process Engineers, and Operations and Maintenance Supervisors
Course Duration – 2 Days

Program Objectives:
Industrial Energy Management in the 21st Century is aimed at improving the delegates' knowledge and understanding of the principles involved in designing and operating continuous processes at optimum efficiency. The primary focus is on process equipment and utilities, with an emphasis on overall systems.

Program Outline:

- Energy Technology
- Steam Systems
- Other Utility Systems
- Process Heat Integration
- Key Process Equipment
- Energy Efficiency Programs and Activities

FIT-E02. Introduction to Pinch Analysis

Instructor – Dr. Alan Rossiter, PhD, P.E., C. Eng.
Who Should Attend - The workshop is aimed at energy managers and engineers involved in plant
operation, troubleshooting and process design in the process industries, including oil refining, chemicals & petrochemicals, pulp & paper and food & beverages.
Course Duration – 2 Days

Program Objectives:
Participants attending the program will learn how to construct composite curves and grand composite curves; calculate energy targets and multiple utility targets; design simple heat exchanger networks using pinch principles; identify situations where pinch analysis is an appropriate tool to use; and organize a successful pinch project.

Program Outline:

- Background
- Energy Targeting and Composite Curves
- The Heat Exchanger Network Design Problem
- Constructing Composite Curves
- DTmin, Qh,min, Qc,min
- DTmin, Qh,min, Qc,min s
- Heat Exchanger Network Design
- The Pinch Principle

- The Grid Diagram
- CP rules
- Multiple Utility Targeting and the Grand Composite Curve*
- The Problem Table and Multiple Utility Targets
- The Grand Composite Curve
- Segmented Utilities
- HEN Design for Multiple Utility Problems
- Retrofit Design
- Industry Examples

FIT-E03. Steam System Management and Optimization

Instructor – Dr. Alan Rossiter, PhD, P.E., C. Eng.
Who Should Attend – The workshop is aimed at energy managers and engineers involved in the operation, troubleshooting and design of steam systems within the process industries.
Course Duration – 1 Day

Program Objectives:
Steam System Management & Optimization is a seven-hour workshop aimed at improving the delegates' knowledge and understanding of the various principles involved in designing and operating steam systems that serve process facilities at optimum efficiency. The workshop is designed to provide very practical assistance in designing and implementing energy efficiency activities.

Program Outline:
Introduction to Thermodynamics
- Review of the First & Second Laws
- Heat and Power

Power Recovery and Cogeneration
- Steam Turbines
- Gas Turbines
- Combined Cycles
- Comparison of Cycle Efficiencies
- Steam Balances
- Boilers
- Deaerators
- Steam Turbines
- Gas Turbines, Heat Recovery Steam Generators and Waste Heat Boilers
- Steam Distribution
- Condensate Recovery

Measures to Improve Steam System Efficiency

FIT-E04. Distributed Control Systems Technology

Instructor – John Hollemans, P. Eng.
Who Should Attend – Engineers and managers who are responsible for the selection and implementation of Distributed Control Systems (DCS), the application of Advanced Process Control (APC) systems or control system revamps.
Course Duration – 4 Days

Program Objectives:
By the end of the program, participants will understand the architecture and operation of a DCS, be able to specify and design a simple DCS, select the best DCS from several vendors, understand ergonomic issues, specify and implement effective alarm strategies, and improve process performance, using APC.

Program Outline:

- Overview DCS, SCADA, PLC
- Data Communications
- DCS Controller Configuration
- Advanced Controllers
- Programming of DCS Systems
- Uninterrupted Operation and Security Issues
- Human Machine Interface
- DCS Alarm System Management
- DCS Data Historian and Reporting Functions
- DCS Configuration Issues
- APC

FIT-E05. Advanced Process Control Systems

Instructor – John Hollemans
Who Should Attend –Managers and engineers who are responsible for the selection and implementation of APC systems and other process plant control systems.
Course Duration – 4 Days

Program Objectives:
By the end of the program, participants will understand the newest APC technologies and how they have changed the way control engineers and their managers can best do their jobs.

Program Outline:

- APC systems basics
- Control Fundamentals
- System Elements and Design Parameters
- Project Phases, Costs, Resources and Benefits
- APC System Vendors

FIT-E06. Applied Control Techniques

Instructor – Hans Eder
Who Should Attend – Process control technicians and engineers, operations support staff, process designers and production supervisors
Course Duration – 5 Days

Program Objectives:
Participants will finish the course with the ability to analyse a situation quickly, to select the best suited technology or controller type, to configure and tune it for highest performance. This course goes far beyond theoretical education with an emphasis on practical use.

Program Outline:

- Objectives and Main Benefits of Control: Objectives, incentives from improved control
- Measurements and Controllers: Main measuring and control elements
- Measurements: Types, selection criteria, characterization and analysis, sampling, noise and filtering
- Process Dynamics: Types of process behavior, steady state and dynamic parameter estimation
- Standard Control Concepts: Hierarchical levels of control, basic concepts, tag processing, cascades.
- Feedback Control, Single Loop: Objective, PID control principle, PID tuning. Performance criteria Standard PID Applications, Other feedback algorithms (Ratio, BTU, etc.)
- Feedback Control, Level Control: Objective, standard approaches. Average and tight level control.
- Dead Time Compensation: Objective, overview, Smith Predictor, Predictive PID
- Feed-forward Control: Objective and concepts. Additive, multiplicative FFW
- Constraint Control: Objective, concepts, static vs. dynamic constraint control, multiple constraints
- Multivariable Control: Multi-loop vs. multivariable control, criteria for variable pairing, tuning
- Model Based Control Introduction: Objectives, criteria, key concepts, tuning, identification
- Optimization Fundamentals: Model-free vs. Model-based Optimization
- Incentive Calculation: Methods, criteria
- Applications Implementation: Application standards, design criteria, user interface, documentation
- Performance Assessment and Monitoring: Key application success factors, on-line monitoring.

FIT-E07. Model Based Control

Instructor – Hans Eder
Who Should Attend – Process control technicians and engineers, operations support staff, process designers and production supervisors
Course Duration – 3 Days

Program Objectives:
Participants will finish the course with the ability to use Model Based Control (MBC) to master the most difficult situations, such as long deadtime, multiple influences or constraints etc. in a relatively easy way. The course teaches the use of simple, easy to build process models based on the standard process parameters like gain, deadtime and time constants. It delivers tight and stable control plus extra information on the condition of the process.

Program Outline:

- Motivation for Model Based Control: Definition, benefits, criteria for use, application areas
- Model types and Selection Criteria: Main types and approaches
- The Main Approaches: IMC, DMC, Hiecon, Monoreg, AMC
- Plant Test: Test types, selection criteria, evaluation of results
- Identification: Estimation of the dynamic process parameters
- Feedback Control: Handling of process changes, model errors, non-linearities, tuning
- MBC Feed-forward Control: Objective and concepts. Additive, multiplicative FFW
- MBC Constraint Control: Objective, concepts, comparison with PID
- MBC Multivariable Control: Objective, concepts, comparison with PID
- MBC Optimization - Introduction: LP based Optimization
- Applications Design and Implementation: Design criteria, user interface, documentation
- Performance Assessment and Monitoring: Key success factors for applications, economics.

FIT-E08. Business Impact of Advanced Process Control

Instructor – Hans Eder
Who Should Attend – Plant Managers, Technical and Operations Managers, Senior Process Control
Engineers
Course Duration – 1 Day

Program Objectives:
The objective of this seminar is to improve the exploitation of APC for the benefit of the plant. It provides sound understanding of the potential contributions of APC, with an emphasis on the economic and operational aspects. Leveraging organizational resources and expertise to the benefit of the plant or corporation are emphasized.

Program Outline:

- Use of APC in Today's Environment
- Benefits of Improved Control Performance
- Impact of APC on Operations
- Converting Challenges into Opportunities
- Planning and Steering Process Control to Maximize Gain, Key Success Factors and Pitfalls
- Benefits of APC

FIT-E09. Automation of Refinery Offsite Operations

Instructor – Dr. Suresh Agrawal
Who Should Attend – Engineers and Operations Professionals
Course Duration – 3 Days

Program Objectives:
This course aims at improving the attendees' knowledge and understanding of the principles of operation and decision-making in offsite operations, such as crude / products blending control and optimization, tank farm management, terminal and custody transfer, oil movements, etc.

Program Outline:

- Tank Farm Management
- Blending Systems and Operation
- Advanced Blend Control and Optimization Systems
- Project Planning, Justification, Implementation and Benefits Realization

FIT-E10. Fuels Blending Technology and Management

Instructor – Dr. Suresh Agrawal
Who Should Attend – Engineers and Operations Professionals
Course Duration – 3 Days

Program Objectives:
This course will cover all technical, operational, modeling and economical aspects of fuels blending control and optimization systems

Program Outline:
- Field Equipment and Operations
- Process Models, Basic Control and Optimization Strategy
- Advanced Blend Control and Optimization Strategy
- Keys to Blending Control Project Execution

FIT-E11. Planning, Optimization, Scheduling and Control of Fuels Blending Systems

Instructor – Dr. Suresh Agrawal
Who Should Attend – Engineers and Operations Professionals
Course Duration – 3 Days

Program Objectives:
This course examines what is involved in blend recipe optimization from theory to models to optimization strategy. The interaction between components and their accurate estimate makes blending non-linear. Efficiency in handling this non-linear function is a key element of the course.

Program Outline:
- Overview of Blend Optimization Strategy
- Single Product Blend Optimization and Planning
- Multi-Product / Multi Period Optimization and Planning
- Syndicated Blend Optimization and Data Analysis

FIT-E12. Principles and Applications of Linear and Non-Linear Programming in the Refining Industry

Instructor – Dr. Suresh Agrawal
Who Should Attend – Engineers, Planners and Operations Professionals
Course Duration – 3 Days

Program Objectives:
The information imparted during this course will introduce the techniques of linear programming. The course will cover all technical, operational, modeling, and economic aspects of planning and optimization of daily refinery operations.

Program Outline:

- Refinery Simulation and Planning
- Non-Linear Models, Programming, and Optimization
- Fuel Blend Optimization and Planning
- Syndicated Blend Optimization and Data Analysis

FIT-E13. Petroleum Refining Fundamentals

Instructor – Dr. Iraj Isaac Rahmim
Who Should Attend – This course serves as an excellent refresher for the refinery chemical engineers and other technical staff, but also as a very informative survey for non-technical professionals including managers and operations and maintenance personnel.
Course Duration – 3 Days

Program Objectives:
Provide understanding of overall refinery structure, operations, feedstocks, products, and economics, as well as individual processing unit operations, technologies, and economics. Topics related to current environmental regulations, product specifications, blending, and petrochemical feedstocks will be examined.

Program Outline:

- Refinery Feedstreams
- Refinery Products and Specifications
- Overall Refinery Structure and Layout
- Atmospheric and Vacuum Distillation
- Light Ends Upgrading
- Gasoline Manufacturing Processes: Isomerization, Alkylation, Reforming, Polymerization
- Catalytic Cracking
- Resid Processing: Coking, Visbreaking
- Hydroprocessing: Hydrocracking and Hydrotreating
- Product Blending
- Petrochemical Feedstocks and Processes

Hydrocarbon Loss

FIT-H01. Measuring and Reducing Hydrocarbon Loss

Instructor – Tudor Rees
Who Should Attend – Planning, scheduling, engineers. Managers interested in reducing hydrocarbon loss and increasing yields.
Course Duration – 2 Days

Program Objectives:
Provide understanding of overall hydrocardon measurement and the calculation of loss. Activities to reduce hydrocarbon loss and increase unit efficiencies and outputs.

Program Outline:

Day 1

- Fundamental Principles of Hydrocarbon Management.
- Measurement Systems (Static)
- Measurement Systems (Dynamic)
- Sampling/ Density and Water
- Overall Uncertainties

Day 2

- Real Losses
- Oil Accounting
- Refinery Audits/Surveys
- Benchmarking
- Implementation of Hydrocarbon Management

Reliability and Asset Availability

FIT-R01. Hazard Analysis

Instructor – Jim Corley
Who Should Attend – Maintenance and engineering professionals who work with plant reliability or asset availability.
Course Duration – 2 Days

Program Objectives:
This course teaches the use of a statistical analysis technique to analyze failure and operations data. Using a modified Weibull analysis called Hazard Analysis, the technique can determine Mean Time To Failure (MTTF), Mean Time Between Failure (MTBF) failure modes, and probability of failure for equipment typically found in the petrochemical industry.

Program Outline:

- Introduction to Hazard Analysis
- Plotting Failure Data
- Using Hazard Analysis Software
- Workshops with Field Cases
- Workshop with Analysis of Client Failure Data

FIT-R02. Vibration Analysis

Instructor – Jim Corley
Who Should Attend - This course is aimed at vibration engineers and technicians who are responsible for solving vibration problems in rotating equipment. The course is for those who have some background in vibration analysis, but not the many years of experience necessary to solve problems.
Course Duration – 3 Days

Program Objectives:
Using actual case histories that simulate the complexities of vibration problems found in petrochemical plants, the course teaches the thought process necessary to solve vibration problems. It exposes the student to the real life problems that might take many years to see in a plant.

Program Outline:

- Review of basic vibration concepts.
- Description and use of the case history software.
- Individual problem solving of up to 50 vibration problems that range from easy to very difficult.
- Overview of Case History Builder program that allows the user to create their own case problems.
- Course includes a plant license for the use of the Case History and Builder programs.

Quality Control

FIT-Q01. Introduction to Process Analyzers

Instructor – Tony Waters
Who Should Attend - Analyzer Specialists and Laboratory Specialists
Prerequisite: Enough Math of Analyzer Technicians or Equivalent Knowledge; Enough Chemistry for Analyzer Technicians or Equivalent Experience
Course Duration – 2.5 Days

Program Outline:

- Introduction What are process analyzers?
- Why are they different?
- Oxygen Analyzers
- Galvanic & Polarographic Membrane Cells
- The Zirconia Cell
- Paramagnetic Devices
- Photometric Analyzers
- UV Photometers, Sources, & Detectors
- IR Photometers, Sources, & Detectors
- Luminescence Analyzers
- Continuous & Pulsed UV Fluorescence
- Flame Photometric Detector (FPD)
- X-ray Fluorescence (XRF)
- Water Quality Measurement pH, Ion-Selective & Redox (ORP) Electrodes
- Conductivity Measurement
- Colorimetric & Titrimetric Analysis
- Total Organic Carbon (TOC) Analyzers
- Residual Chlorine, Turbidity, & Oil in Water
- Moisture Analyzers Chilled Mirror
- Electrolytic & Alumina Sensors

- Quartz Crystal
- Gas Chromatographs Basic Principles
- Column Switching
- Sequencing Logic & Peak Measurement Techniques
- Calibration
- Physical Property Analyzers
- Introduction to ASTM Tests
- Density & Viscosity Analyzers

FIT-Q02. Introduction to Photometric Analyzers

Instructor – Tony Waters
Who Should Attend - Analyzer Specialists and Laboratory Specialists
Prerequisite: Enough Math of Analyzer Technicians or Equivalent Knowledge; Enough Chemistry for Analyzer Technicians or Equivalent Experience
Course Duration – 2.5 Days

Program Objectives:
By the end of the program, participants will understand all the basics of process analyzers and their use.

Program Outline:

- Properties of light; the electromagnetic spectrum
- Waveforms and the units of wavelength, wavenumber & frequency
- The relationship between radiant energy and wavelength
- Emission and absorption of radiant energy by molecules with associated spectra
- Theory of absorption; Beer-Lambert Law
- Photometric methods using EM radiation absorption
- Different layouts of optical bench; dual & single beam instruments
- The ultraviolet region of the spectrum
- Mechanisms of UV energy absorption by molecules
- Principles of photometric analysis using non-dispersive ultraviolet absorption (NDUV)
- Typical ultraviolet lamps & detectors
- Optical bench arrangements; reference cells & UV filters
- Typical Applications of NDUV analyzers
- The infrared “fingerprint” spectral region
- Mechanism of infrared absorption by molecules
- Beam path-length and sample pressure effects
- The Luft detector; principles of operation and variations in construction
- Solid state IR detectors; pros & cons
- IR sources; collimators & beam splitters; optical filters
- Typical Applications of NDUV analyzers
- Brief introduction to fluorescence, chemiluminescence, and x-ray
- UV and X-ray fluorescence measurement techniques

FIT-Q03. Troubleshooting Sampling Systems

Instructor – Tony Waters
Who Should Attend - Analyzer Specialists and Laboratory Specialists
Course Duration – 2.5 Days

Program Objectives:
This course teaches participants the principles of process analyzer design and troubleshooting

Program Outline:

- Basic performance criteria & difficulties arising
- Some issues of *compatibility*
- Some issues of *timeliness*
- Some issues of *representation*
- Other design requirements; reliability, cost-effectiveness & safe operation
- Exponential mixing & time delay in larger volumes
- Molecular diffusion and the delay it causes in “dead legs”
- Adsorption of gases on surfaces
- Permeation of gases through porous tubes & fittings
- How to evaluate the process tap location
- Types of sample probes and their uses
- When sample preconditioning at the process tap is advisable
- Time delay in flowing liquids
- Gas compressibility & its affect on time delays
- Evaluating the performance of a single-line sample transport system
- Simple time delay calculations for liquids and gases
- Features of a fast-loop sample transportation system
- How to increase the speed of response; six variables to optimize
- Phase separations; typical sample conditioning hardware & its characteristics
- Saturated vapor pressure – when do gases condense and by how much?
- The difference in composition of vapor and liquid, when both present
- Phase preservation; how to avoid condensation or bubbling
- Troubleshooting failure caused by an incorrect sequence of operations
- Volume change during condensation or vaporization
- Time lag & fractionation problems caused by vaporizers & how to correct them
- Ways to avoid dead legs & mixing volumes
  Effective multi-stream & calibration switching methods
- Sample disposal and recovery systems

FIT-Q04. Improving Sample System Reliability

Instructor – Tony Waters
Who Should Attend - Analyzer Specialists and Laboratory Specialists
Prerequisite: Troubleshooting Sampling Systems; a laptop is strongly recommended
Course Duration – 2.5 Days

Program Objectives:
This course teaches the student how to understand process conditions and match them to analyzer characteristics and sample requirements.

Program Outline:

- How to specify a process nozzle
- Sample tap & probe design issues
- When a field station is essential … or desirable
- How to sample high-pressure gas lines
- How to vaporize a liquid sample at the process tap location

- Design issues for fast loops and sample return lines
- Figuring the required flow rate (it's not just time delay!)
- Calculating the required fluid flow velocity in each line segment
- Laminar or turbulent flow? Calculating Reynolds Number
- The effect of line temperature and pressure on fluid viscosity and density
- Calculating the pressure drop in each line segment
- Add the effect of line elbows and elevation change
- Turbulent friction factors for typical transport line conditions
- Exercises with a spreadsheet pressure-drop calculation (student laptop required)

- When & how to condense or vaporize a sample
- Dealing with aerosols, emulsions & foams
- Saturated vapor pressure – when do gases condense and by how much?
- Phase diagrams; bubble point, dew point, triple point and critical point
- Exercises with a commercial dew point program (student laptop required)

- Review of NeSSI specifications, expectations and current status
- Using status indicators and controls
  How to configure modular systems
- Exercises with a commercial configuration program (student laptop required)

FIT-Q05. Process Gas Chromatographs

Instructor – Tony Waters
Who Should Attend - Analyzer Specialists and Laboratory Specialists
Prerequisite: Enough Chemistry for Analyzer Technicians
Course Duration – 2.5 Days

Program Objectives:
This course teaches the basis ad proper care and usage of gas chromatographs

Program Outline:

- Origin & development of gas chromatography
- Choice of carrier gas, purity and flow path
- Carrier pressure control by mechanical or electronic regulators
- Sample injection valves for gases & liquids; sample volume considerations
- Sample conditioning requirements
- Types of gas chromatographic columns
- Typical separation achieved by polar & non-polar columns
- Thermal conductivity detector (TCD); features & issues
- Flame ionization detector (FID) for hydrocarbons; features & issues
- Flame photometric detector (FPD) for sulphur compounds; features & issues
- Temperature control requirements; typical GC oven designs
- Start up procedures; how to balance the carrier gas flow rates
- Getting a flat baseline; noise, drift & auto-zeroing
- Setting the analysis cycle time and peak gate timing
- Baseline correction routines; choosing the best compensation
- Integration of peak area, calibration & response factors
- Types of column switching valves
- Parallel separation as an alternative to complex systems
- How backflush works; valve timing issues
- How to set up and troubleshoot a backflush system
- Why heart cut is always used for trace analysis
- How heart cut works; valve timing issues
- How to set up and troubleshoot a heart cut system
- Single & multiple heart-cut techniques

FIT-Q06. Advanced Topics in Gas Chromatography

Instructor – Tony Waters
Who Should Attend – QC, Analyzer Specialists and Laboratory Specialists
Prerequisite: Basic Gas Chromatography or Equivalent Experience
Course Duration – 2.5 Days

Program Objectives:
By the end of the program, participants will understand all the basics as well as advanced techniques with gas chromatography

Program Outline:

- Definition of chromatographic terms
- Different types of chromatographic column and how they are made
- Gas-liquid equilibrium; four important variables
- An animated model of the chromatographic process
- Effect of more equilibria & concept of theoretical plates
- What determines peak shape?
- What determines peak width?
- What *really* causes peak separation?
- How a chromatogram is formed
- Position of components on chromatograms; how to identify unknown peaks
- Peak separation and resolution; evaluating overlapping peaks
- Detailed study of chromatograms; how to find valuable performance data there
- Know when a column is working optimally, or not
- Know when columns are damaged (and must be replaced)
- How to optimize column performance by column temperature or liquid phase loading
- How to improve peak resolution by optimizing the carrier flow
- How to tune a column for the fastest analysis time
- How column backflush *really* works (ideally and in practice)
- Understand the enormous effect of pressure drop in a dual column system
- How to evaluate and improve existing dual column designs
- Methods for troubleshooting backflush systems
- How to diagnose unexpected *peaks, spikes, bumps and steps* in the baseline
- Detailed review of the heart-cut technique
- Single & multiple heart-cut techniques
- How to set up a complex heart-cut system & evaluate its performance
- Methods for troubleshooting heart cut systems

FIT-Q07. Enough Chemistry for Analyzer Technicians

Instructor – Tony Waters
Who Should Attend – QC, Analyzer Specialists and Laboratory Specialists
Course Duration – 2.5 Days

Program Objectives:
By the end of the program, participants will have enough Chemistry background to understand the importance of tests and results

Program Outline:

- Elements, mixtures & chemical compounds
- Atoms & molecules; symbols, formulae & molecular structure
- The Bohr model for electronic structure of atoms; periodic table
- The noble gases; why are they chemically inert? Explaining valency
- How positive ions are formed; the nature of the ionic bond
- General properties of ionic compounds; crystals & solutions
- Explanation of covalent bonding; Lewis diagrams for methane, ammonia & water
- General properties of covalent compounds
- Ways that radiated energy interacts with molecules; causes of electromagnetic spectra
- Typical process analyzers using spectral absorption or emission
- Typical positive & negative ions
- How polyatomic negative ions are formed; e.g. $(OH)^-$, $(SO_4)^{2-}$, etc.
- Ionization of water; pH value, reference & measuring electrodes
- How to deduce the formulae of ionic compounds
- What happens in a chemical reaction?
- Chemical equations
- Introduction to the hydrocarbons; exercises with molecular models
- Review of hydrocarbon families: paraffins, olefins, acetylenes, naphthenes & aromatics
- Understanding the meaning of hydrocarbon names and abbreviations
- Class exercises in naming a hydrocarbon structure & deriving structure from a chemical name
- Atomic & molecular weight
- How to calculate gas density from molecular weight
- Introducing the Mole, unit of chemical quantity
- Some examples of molar calculations used in analytical chemistry
- How to convert concentration units: Vol.% <> Mol.% <> Wt.%

FIT-Q08. Enough Physics for Analyzer Technicians

Instructor – Tony Waters
Who Should Attend – QC, Analyzer Specialists and Laboratory Specialists
Prerequisite: Enough Math for Analyzer Technicians
Course Duration – 2.5 Days

Program Objectives:
By the end of the program, participants will have enough Physics background to understand the workings of the analyzers in the process

Program Outline:

- Velocity, acceleration and gravity
- Newton's Laws: momentum, force & equilibrium
- Machines; mechanical advantage
- Conservation principles of momentum & energy
- Density, specific gravity & buoyancy
- Pressure & temperature change in flowing fluids
- Class exercises applying the ideal gas laws to flowing gases
- Compressibility factor
- Fluid flow and pressure drop in tubing and components
- Fluid density & viscosity; pour point, cloud point & freeze point
- Surface tension & refractive index
- Infrared radiation, convection and conduction
- Heat content of gases & liquids
- Specific heat and latent heat of phase change
- Thermal conductivity of solids & gases; thermal insulation of lines
- Flash point
- Heating value
- What really causes pressure and temperature?
- Kinetic theory of gases
- Dalton's Law of partial pressure
- Making calibration mixtures by partial pressure
- Condensation; saturated vapor pressure, dew point & relative saturation
- Boiling point of a pure liquid – pressure effect
- Phase diagrams of pure & mixed liquids; bubble point, dew point & critical point
- Fractionation of a mixed liquid – how distillation works
- Initial boiling point (IBP), boiling range & final boiling point (FBP)
- Flash vaporization of mixed liquid samples

FIT-Q09. Enough Math for Analyzer Technicians

Instructor – Tony Waters
Who Should Attend - QC, Analyzer Specialists and Laboratory Specialists
Course Duration – 2.5 Days

Program Objectives:
By the end of the program, participants will have enough Math background to understand the workings of the analyzers in the process

Program Outline:

- Addition, subtraction & multiplication; Division; fractions & decimals
- Some short cuts for mental work
- Squares, square roots & exponents
- Multiplying & dividing powers; logarithms
- Representing variable by symbols
- Equation for a straight line
- Manipulating an equality
- Solving linear equations (e.g. Ohm's Law or Ideal Gas Law)
- Solving equations with one unknown containing exponents
- Area of a rectangle, volume of a rectangular solid; Area of a triangle, volume of a triangular or square pyramid
- Perimeter & area of a circle, volume of a cone, cylinder or sphere
- Properties of isosceles, equilateral and right-angled triangles
- Pythagoras' Theorem; the 3-4-5 triangle
- Ratio of sides for a right triangle; sine, cosine & tangent of an angle
- Practical applications of trigonometry
- Introduction to risk and probability
- Sum & product of probabilities
- Median & average (mean) of a set
- Nature of experimental error
- Standard curve of error
- Calculating the standard deviation
- Precision & confidence limits
- General idea of linear regression, for line of best fit
- Boolean algebra
- Conditional logic; truth tables

FIT-Q10. Measurement and Uncertainty

Instructor – Tony Waters
Who Should Attend - QC, Analyzer Specialists and Laboratory Specialists
Course Duration – 2.5 Days

Program Objectives:
By the end of the program, participants will have enough measurement complexity understanding, along with principles of precision and accuracy background to properly perform measurements in the laboratory

Program Outline:

- What exactly is a measurement?
- Understanding continuous & discrete variables
- The three items necessary to define any measurement completely
- Systems of units: SI and Imperial
- Dimensions; the seven base measurements
- A detailed review of the seven base measurements
- Some derived units and their dimensions
- The dimensionless units widely used in analytical measurements
- The standard prefix system for larger & smaller units
- Knowing the proper format for unit names & symbols
- How to properly format numbers
- Understanding the concept of significant figures
- Using the scientific notation
- Understanding the difference between mistakes, precision & accuracy
- Defining repeatability & reproducibility
- Class exercises in measurement uncertainty
- Random error and standard deviation
- How to calculate standard deviation
- The normal distribution and how it can be used for statistical prediction
- Systematic error; what it is and how to minimize it
- Limitations due to calibration error
- Advantages of validation
- How to construct a Control Chart
- Using the chart to predict failure and to guide proactive maintenance
- Typical SQC decision rules
- When to calibrate, maintain or leave alone!
- Methods of validation and calibration

FIT-Q11. Physical Property Measurement

Instructor – Tony Waters
Who Should Attend - QC, Analyzer Specialists and Laboratory Specialists
Prerequisite: Enough Physics for Analyzer Technicians or Equivalent Experience
Course Duration – 4.5 days

Program Objectives:
By the end of the program, participants will have enough physical property understanding to properly perform measurements in the laboratory

Program Outline:

- Introduction to physical property "analyzers"
- Nature of ASTM Tests
- Definition of density & specific gravity (relative density)
- Pyncometer and hydrometer methods
- Archimedes principle and buoyancy methods
- U-tube, spool, radiation absorption analyzers, Coriolis mass flow meters
- Definition of viscosity and explanation of units
- Fluid flow characteristics
- Capillary and equiviscous viscometers
- Vibrating probe and sphere viscometers
- Rotational and falling piston viscometers
- Cold properties: pout point and cloud point defined
- Pour point ASTM laboratory test
- Pour point by differential pressure or viscous drag methods and analyzers
- Cloud point ASTM laboratory test
- Cloud point measurement using light refraction/reflection methods
- Boiling point defined
- Discussion of flash vaporization and distillation methods
- Distillation and simulated distillation analyzers
- Ignition Properties: flash point and octane number
- ASTM methods for determining flash point
- Flash point analyzers
- CFR octane engine and other octane methods
- Refractive index measurement & applications

FIT-Q12. Water Quality Analyzers

Instructor – Tony Waters
Who Should Attend - QC, Analyzer Specialists and Laboratory Specialists
Prerequisite: Enough Chemistry for Analyzer Technicians or Equivalent Experience
Course Duration – 2.5 Days

Program Objectives:
By the end of the program, participants will have enough water quality measurement information, including process and environmental, to properly perform measurements in the laboratory

Program Outline:

- Introduction to water quality measurement; process & environmental
- Ionization of water; definition of pH value
- Electrochemical theory
- Electrodes & cells
- pH, ORP & ion-selective electrodes; limitations and interferences
- Some issues of pH maintenance and pH process control
- pH calibration techniques
- Conductivity cells and meters
- Conductivity electrode calibration techniques
- Measurement of water purity by ionic conductivity
- Dissolved oxygen measurement
- Principles of polarographic & galvanic sensors
- Calibration methods for dissolve oxygen sensors
- Wet chemical analysis by automatic titration or colorimetric analysis
- Measuring silica and hydrazine in boiler feed water
- Troubleshooting techniques
- The chemical effects of chlorinating water
- Measuring total free chlorine or residual chlorine in water
- Review of biological oxygen demand (BOD) & chemical oxygen demand (COD)
- Measuring total carbon (TC) or total organic carbon (TOC)
- Oil or volatile organic compounds (VOC) in waste water
- Turbidity measurement devices

FIT-Q13. Oxygen, Sulphur and Nitrogen Analyzers

Instructor – Tony Waters
Who Should Attend - QC, Analyzer Specialists and Laboratory Specialists
Prerequisite: Enough Chemistry for Analyzer Technicians or Equivalent Experience, Introduction to Photometric Analyzers
Course Duration – 2.5 Days

Program Objectives:
By the end of the program, participants will have enough sulphur and nitrogen measurement information to properly perform measurements in the laboratory

Program Outline:

- Introduction to oxygen and its properties
- Principles of zirconia sensors; calibration method
- Principles of paramagnetic oxygen sensors
- Dumbbell, magnetic wind and Quinke methods
- Applications of paramagnetic sensors
- Measurement limitations and interferences
- Introduction to sulphur and its compounds
- Properties of sulphur oxides, organic sulphides & mercaptans
- Government requirements for SO_x and total sulfur in fuels
- Sulphur analysis by selective ion electrode or conductivity sensor
- Issues of cross interference by non-target gases
- Lead acetate paper tape method & troubleshooting tips
- Photometric Sulphur compound analysis using non-dispersive ultraviolet absorption (NDUV)
- Discussion of UV fluorescence, chemiluminescence, and photo-ionization techniques
- SO_2 fluorescence measurement
- FPD, SCD, and PID detectors
- Oxidation of samples for total sulfur measurement
- Photometric sulphur compound analysis using non-dispersive infrared absorption (NDIR)
- X-ray fluorescence and absorption methods of analysis for total sulfur in liquids
- Introduction to nitrogen compounds; properties of oxides, ammonia and amines
- NOx chemiluminescence principles; gas interference issues
- NO_2 converters and ozone generators
- Photometric nitrogen compound analysis using non-dispersive ultraviolet absorption (NDUV)
- Photometric nitrogen compound analysis using non-dispersive infrared absorption (NDIR)
- Oxidation of samples for total nitrogen measurement
- Nitrogen compound electrochemical sensors: principles and issues

FIT-Q14. Significance of Lab Test Results for Refinery Products and Process Streams

Instructor – Jim Maynard
Who Should Attend – Laboratory Chemists, Technical Associates and Bench Technicians
Course Duration – 2.0 Days

Program Objectives:
By completion of the course, participants will understand the significance of providing accurate test results for release of refinery products and for monitoring critical properties of process streams, including possible negative scenarios when inaccurate test data is provided by the refinery support lab.

Program Outline:

- Critical properties measured in process streams and products for release (tailored to each refinery).
- Accuracy and precision of the test methods used to measure these critical properties.
- Significance of providing accurate test results for these critical properties.
- Possible product and refinery operational problems caused by inaccurate lab test results for these critical properties.
- The potential cost of providing inaccurate test results for these critical properties.

FIT-Q15. Quality Assurance for Process Operators

Instructor – Jim Maynard
Who Should Attend – Process Operators
Course Duration – 2.5 Days

Program Objectives:
This course is an introduction to basic quality assurance practices. Upon completion, process operators will know how to properly obtain process samples and will have a good understanding of the importance of quality assurance in fuels blending.

Program Outline:

- Total Quality Management (TQM) and economics.
- Customer service and personal effectiveness.
- Communication and team skills.
- Variance and operating consistency.
- Continuous improvement and corrective/preventive action.
- Group problem solving.
- Process and product specifications.
- Process and product sample collection.
- Statistical application to process operations
- Process and test data collection.
- Control charts and process capability.

Safety

FIT-S01. Multiple Cause System Oriented Incident Investigation (MCSOII)

Instructor – Bill Helmer
Who Should Attend – Safety Personnel
Course Duration – 1 Day

Program Objectives:
This course will provide participants with a thorough understanding of the causes and effects of loss and teaches the skills needed to conduct a systematic incident investigation. The MCSOII methodology is a modified fault tree technique, which looks for multiple causes of a top event. These causes are not just those that actually resulted in the top event but also those which could have resulted in the same top event. The targeted causes are the management system failures that could have caused (or lead) to a top event.

Program Outline:

- The participant will demonstrate the ability to determine root causes by use of the MCSOII methodology.
- The participant will be able to arrive at effective remedial actions and follow-up to prevent incident recurrence.
- The participant will be able to identify the difference between root causes and basic causes.
- The participant will be able to demonstrate on a logic tree if the process has reached the final stage or a management system root cause.
- The participant can demonstrate their understanding that a complete analysis includes not only specific causes identified with the incident but all potential basic and root causes which might have led to the incident.

FIT-S02. Principles of Flammability

Instructor – Bill Helmer
Who Should Attend – Safety Personnel
Course Duration – 2 Days

Program Objectives:
This course will provide participants with a thorough understanding of the principles of flammability inside of a chemical or petroleum facility. The objective is to provide engineers with an understanding of how to recognize a potential flammability situation, how to evaluate it, and how to control it.

Program Outline:

- The fire triangle as the basis for understanding flammability and for preventing undesired fires and explosions
- Flammability terms
- Flammability diagrams where to find them, how to use them, how to construct them
- Flammability in gases, liquids, solids, and dusts
- Deflagrations and Detonations, how they occur, and how to prevent
- An overview of NFPA and OSHA regulations concerning the use and storage of flammables
- Venting and ventilation requirements

FIT-S03. Process Hazard Analysis Methodologies

Instructor – Bill Helmer
Who Should Attend – Safety Personnel
Course Duration – 3 Days

Program Objectives:
This course will provide participants with a thorough understanding of the principle types of process hazard evaluation methodologies used in OSHA and EPA required process hazard analyses, PHAs. At the completion of the course and examination the students will be provided a certificate that they are “knowledgeable” in the process hazard methodology.

Program Outline:

- The “What If” methodology
- “What If/Checklist” methodology
- Failure Modes and Effects, FMEA
- Hazard and Operability Study, HAZOP

FIT-S04. Process Hazard Analysis (PHA) Team Leadership

Instructor – Bill Helmer
Who Should Attend – Safety Personnel
Course Duration – 5 Days

Program Objectives:
This course will provide participants with a thorough understanding of requirements for leadership of an OSHA or EPA required process hazards analysis, PHA, in each of the principal types of process hazard evaluation methodologies referenced by these agencies. While the course does teach the basics of each of the PHA methodologies, the emphasis is on leading the PHA team in doing its required activities and managing the use of these scarce company resources. At the completion of the course and examination the students will be provided a certificate that they are "knowledgeable" in the process hazard methodology and in the requirements of a PHA team leader.

Program Outline:

- The "What If" methodology
- "What If/Checklist" methodology
- Failure Modes and Effects, FMEA
- Hazard and Operability Study, HAZOP

Supply Chain

FIT-SC01. Basic Supply Chain Management

Instructor- Mark Berryman
Who should attend- The course is aimed at managers, superintendents, and supervisors who deal with supply chain issues.
Course duration- 1 day

Program Objective:
To provide a basic overview of the supply chain to individuals who use it on a frequent basis.

Program Outline:

- What is Supply Chain Management (SCM)?
- Supply Chain Management Issues
- Distribution Network Configuration
  Number and location of:
  Suppliers
  Production facilities
  Distribution centers
  Warehouses and customers

- Activities/Functions of SCM
- Discuss several models of SCM in relationship to:
  Strategic
  Tactical
  Operational

- SCM Business Process Integration
- Key Supply Chain Process:
  Customer Relationship Management
  Customer Service Management
- Demand Management
- Order Fulfillment
- Manufacturing Flow Management/Support
- Supplier Relationship Management
- Product Development and Commercialization
- Returns Management

- Emerging Technologies
  Radio frequency Identification
  Etc.

FIT-SC02. Introduction to Inventory Management

Instructor- Mark Berryman
Who should attend- The course is aimed at managers, superintendents, and supervisors who deal with inventory and warehouse management.
Course duration- ½ day

Program Objective:
To provide a basic overview of the supply chain to individuals who use it on a frequent basis.

Program Outline:

- Identify Key Concepts:
- Inventory ,
- Re-order,
- Carrying Costs ,
- Valuation, Concepts,
- Safety Stock,
- Make to Order or Stock,
- Demand Variability,
- Pareto ABC,
- Inventory Reduction,
- Accuracy-Cycle Counting
- Be able to identify the constraints to Inventory.
- Space
- Financial
- Lead Time
- Understand ways to increase capacity through Inventory Management.

FIT-SC03. Production Scheduling in a Lean Environment

Instructor- Mark Berryman
Who should attend- The course is aimed at managers, superintendents, and supervisors who deal with Production Scheduling challenges.
Course duration- 1day

Program Objective:
To provide a basic overview of the Production Scheduling process to individuals who use it on a frequent basis.

Program Outline:

- Impact of Lean on manufacturing operations (processes, inventory deployment, material flow)
- Key Concepts – value stream, flow, waste areas, flow enablers

- How traditional MRP like scheduling lengthens lead times, and builds inventory (transit days, EOQ due to long lead times)
- How to use inventory to buffer uneven demand (customers who's order patterns are erratic) – big deal with Master Automatic – need to show how to look at inventory from a time based perspective (for example – 2 weeks' worth of inventory instead of 2000 pieces)
- Capacity planning – looking out to see where the constraints are for each product line and how to address each one (overtime or inventory)
- Scheduling –
- Sequencing jobs by work center
- Prioritizing shared work centers
- Pull instead of scheduling
- Between work centers
- Between work centers and suppliers
- Review basic concepts and tools to streamline your supply chain
- Understand some key implementation considerations
- Hands on exercise with kanban – learn how to size and implement

Information Systems

FIT-I01. Information Systems Project Management Framework

Instructor – Susan Starr or Steve Stein
Who Should Attend – IT professionals
Course Duration – 2.5 Days

Program Objectives:
This course will provide participants with a practical methodology for scoping, designing, and managing information systems projects. It discusses methods for choosing application software, doing justifications, building AFEs, setting scope and measurement criteria. It provides guidance and documented examples on how to manage the project, once underway and how to be sure that both quality is delivered and user expectations are met.

Program Outline:

- Introduction: The Value of Project Management
- Course Objectives
- The Project Manager Role
- Project Sponsor, Stakeholders, Steering Committee, and Core Team
- Project Management Processes
- Deliverables and Receivables
- Project Charter and Execution Plan
- Estimating
- Change Control
- Tracking Budget and Schedule
- Managing Risks
- Communications
- Project Close
- Benefits Realization

Organizational

FIT-O01. Professional Excellence, Communication Skills and Professional Ethics

Instructor – Dr. Alan Rossiter, PhD, P.E., C. Eng
Who Should Attend – The audience for this course is engineers
Course Duration – (2) Half Days

Program Objectives:
This pair of courses is designed to enhance professional standards and management skills for engineers. They are also accepted by the Professional Engineering Boards of most states for 4 PDH Credits each. Each course has a duration of 4 hours.

Program Outline:

- In Search of Professional Excellence Workshop
- Why people work
- Motivation in the workplace
- Foundations of professional excellence
- Seven elements of professional excellence
- Ethics basics
- Codes of ethics for engineers
- Ethics case studies.
- On the Right Wavelength: Communications Skills and Ethics
- Effective Presentations
- Leading & Influencing through Communication
- Problem Solving in Ethics

Exploration and Production

FIT-EX01. Fundamentals of the Petroleum Industry

Instructor – Angus Warren
Who Should Attend – People wanting to understand the workings of the Exploration and Production sector
Course Duration – 1 - 3 Days
Cost – Depends on Contecct

Program Objectives:
To provide attendees with a high level perspective of the petroleum industry as enjoyed by the CEO of an IOC, or the Director General of an NOC, or a Petroleum Minister.

Program Outline:

- Petroleum Geology
- Structural Characteristics of the Petroleum Industry
- Oil Supply Chain/Gas Supply Chain
- Basics of Oil and Gas Exploitation and Recovery
- Life Cycle of a Project
- Oil and Gas Project Development Concepts
- Methods of State and Foreign Participation
- The E&P Company Business Model
- Government Policies
- Geopolitics
- Project Investment Appraisal Techniques
- Decision Making Under Conditions of Risk and Uncertainty
- Midstream Transportation Options
- Refining and Trading Interfaces
- Gas and Markets
- Stranded Gas and Monetization
- Liquified Natural Gas
- Gas to Liquids
- Joint Ventures
- Safety, Environment, Decommissioning
- Oil and Gas Contracts
- Key Features of the Petroleum Industry

FIT-EX02. Well Completion Design

Instructor – Hemanta Mukherjee
Who Should Attend – Engineers with 1-2 years experience in field operations in the area or cross training from other areas of expertise
Objectives – General broad exposure to oil and gas well completion design engineering with some hands on problem solving
Course Duration – 5 Days

Program Objectives:
To introduce the basics of well completion design

Program Outline:
- Introduction to Production System Analysis (half a day)
- Importance of completion designs for production enhancement (half day)
- Completion Types and Selection Criteria (half a day)
- Prefrac design tests- Minifracs etc (half day)
- Hydraulic Fracture design, treatment and monitoring (1.5 days)
- Proppants and Fluids (half day)
- Pre- and Post Fracture Evaluations (one day)

FIT-EX03. Well Performance and Production Optimization

Instructor – Hemanta Mukherjee
Who Should Attend – Production engineers with 1-5 years experience in the area or those who are cross training from other areas to Production Engineering
Course Duration – 5 Days

Program Objectives:
To introduce the basics of oil and gas well production optimization and well performance surveillance

Program Outline:
- Introduction
- Inflow Performance
- Tubing and Flow line calculations
- Production Systems Analysis
- Importance of Well Logs and Well Tests
- Basic Artificial Lift
- Well Problems
- Basics of Well Candidate Recognition for production optimization

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