Title: Fundamentals of Process Engineering

Potential PDH: 40 **Code:** BTT028

Description:

This course covers the broad field of process engineering from the development of a process flow schematic to the evaluation of operating and proposed technology. As always, the course will be presented in interactive format with many industrial examples. Nineteen case studies from process engineering will be used to illustrate the concepts discussed during the lecture portion. Participants will have the opportunity to solve sample problems with the help of the professor.

Outline:

DAY 1: Fundamentals of Process Engineering – the Basics

- Developing a Flow Diagram
  - Block Diagrams – Linear Programs
  - Process Symbols
  - Process Flow Diagram
  - Developing a PFD from Reaction/Separation Data
  - Brief Look at P&IDs
  - Case Study 1: Methanol to Olefins Process
- Fundamental Balances and Their Use
  - Mass Balance
  - Energy Balance
  - Momentum Balance
  - Case Study 2: Metathesis Plant
- Reaction Yields
  - Stoichiometry
  - Yield, Selectivity, and Recovery
  - Development of a Balanced Stoichiometric Equation
  - Case Study 3: Stoichiometric Equation from Cracking Yields
- Process Control
  - Setting Up a Control System – Basics
  - Types of Control
  - PID Control Calculations
  - Fuzzy Logic and Digital Systems
  - Case Study 4: Interacting Tanks with Fuzzy Logic Process Control

DAY 2: Transport Processes

- Fluid Flow
  - Pressure Units
  - Conversion of Pressure Units to Head
  - Bernoulli Equation
  - Correction of Bernoulli Equation for Real Systems and Unsteady State
  - Pressure Drop Calculation: Single Phase, Mixed Phase
  - Case Study 5: Transfer Line
- Fluid Flow Equipment

- Pumps
- Pump Curves: Vendor and System
- Compressors
- Calculating Head and Power Requirements
- Case Study 6: Charge Gas Compressor

• Energy Value and Heat Transfer
- Value of Steam in Power Cycle
- Value of Different Levels of Refrigeration
- Mechanisms of Heat Transfer: Convection, Conduction, Radiation
- Composite Structures (including Insulation) and Fouling Analysis
- Case Study 7: Pipe Insulation
- Case Study 8: Pinch Technology

• Heat Transfer Equipment
- Pinch Technology
- Types of Heat Exchangers (including TEMA Designation)
- Overall Heat Transfer Coefficient – Estimation and Rigorous Calculation
- Heat Exchanger Sizing Techniques
- Case Study 9: Quench Water heat Exchangers

DAY 3: Processes Containing Solid Phase Systems – Reactors, Adsorbers, Settlers, Fluidization, etc.

• Principles of Reaction Kinetics
- Types of Reactions
- Analysis of Reaction Data
- Case Study 10: Monod Kinetics

• Reactor Design
- Types of Reactors
- Key Considerations
- Selection Map
- Balancing Heat and Mass Transfer
- Case Study 11: Ethylene Oxide Production

• Adsorption
- Concept of an Isotherm
- Identification of the Type of Adsorption
- Breakthrough Analysis
- Calculation and Consequences of Cycle Time
- Case Study 12: Development of a Breakthrough Curve

• Fluidization and Settling
- Settling Velocity – Concepts and Calculation Techniques
- V-L-L Separators
- Settlers
- Liquid-Solid Fluidization – Applications and Calculations
- Gas-Solid Fluidization – Applications and Calculations
- Transport Reactors – Fast Fluidization
- Case Study 13: Fluidized Bed Bioreactor

DAY 4: Separation Technology

• Vapor –Liquid Separators
- Concept of the Flash

- Vapor-Liquid Equilibrium
- Flash Curves
- Boiling Point Curves
- Dew Point, Bubble Point
- Standardized Testing
- Case Study 14: Chilling Train for Feed to a Demethanizer

• Fractionation
- Types of Distillation – Ordinary, Heat Pump, Reactive
- Binary Distillation
- Batch Distillation
- Calculation Techniques
- Short Cut Techniques
- Tower Loading and Sizing
- Types and Design of Internals – Trays and Packing
- Case Study 15: Propylene Fractionation for PG Propylene

• Other Types of Separation
- Absorption
- Extraction
- Extractive Distillation
- Gel Extraction
- Freeze Drying
- Case Study 16: Extractive Distillation for C4s

DAY 5 : Overview of the Processing Industry

• Major Processes
- Refinery Operations
- Petrochemical Processing
- Chemicals Processing
- Moving Downstream
- Case Study 17: Alternative Fischer Tropsch Processing

• Recent Process Developments
- New Technology
- Upgrade of Old Technology
- Impact on Capital and Operating Costs
- Case Study 18: LNG Processes

• Process Evaluation
- Capital Cost Techniques Including Economies of Scale
- Cost of Production Analysis
- Payback Evaluation Techniques
- Case Study 19: ORR – the Overall Rate of Return

Instructor:

Professor Gennaro “Jerry” Maffia (USA), MBA, PhD has 20 years of industrial experience at ABB Lummus Co., Air Products & Chemicals Co., and ARCO Chemical Co. Then after two decades as full professor and department chairman at Widener University, Dr. Maffia joined Manhattan College as full professor of chemical engineering. During his time in academia, he has maintained an active consulting practice with assignments on 6 continents. As an R&D manager and researcher, he developed new manufacturing processes including biomolecule production & separation, and propylene production

technologies. Dr. Maffia was responsible for the design and start-up of major petrochemical plants throughout the Middle East, North America, Europe and Asia. His client list includes: Petrosar, Sarnia, Ontario; PEMEX, La Cangreherra, Mexico; Gulf Oil, Cedar Bayou, Texas; CONOCO / Monsanto, Chocolate Bayou, Texas; ARCO Chemical, 11 propylene oxide plants around the world; and VERAX, Inc., Lebanon, NH. He also worked on EDC plants in Greece and other locations in the Middle East. Dr. Maffia was also part of the team that designed ethylene plants in Fife (UK), Saudi Arabia, Korea, Australia, Qatar, Abadan and Basra. Dr. Jerry Maffia has more than 35 years of process simulation experience including Aspen, ProVision, Hysys, Fluent, and CFD2000. Dr. Maffia participated in, consulted on, and/or managed the design, development, and evaluation of new processes for the production of olefins from natural gas and from gas oil, dimerization of olefins, metathesis of ethylene and butylene to propylene, production and use of epoxides, ethers, alcohols, and styrene, utilization of collagen for cell culture, bioseparations and environmental processes. Dr. Maffia graduated from Manhattan College (New York) with his Bachelors and Masters in Chemical Engineering. He also holds an MBA (Economics) from New York University, and his PhD in Engineering (Chemical) from Dartmouth College. He is a member of the American Chemical Society, American Institute of Chemical Engineers, American Association of University Professors, Tau Beta Pi, Phi Kappa Phi, Phi Beta Delta (International Scholars), Materials Research Society, American Association of Engineering Educators, Delaware Valley Science Council, Junior Achievement of the Delaware Valley, Chemical Consultants Forum, and the Catalysis Club of Philadelphia.