

MEM in Chemical and Process Management

Course Content

CH-506: Applied Chemical Thermodynamics

Review of thermodynamics properties & other basic concepts; Second law & Entropy Calculations; Equilibrium and observable change; Changes in entropy with changes in P, V, and T. Helmholtz function & correlations. Gibbs function G & correlations. Fundamental equations of thermodynamics. Maxwell relationships. Properties of mixtures of ideal gases. G for ideal and non-ideal gases, Excess Thermodynamic Functions, colligative properties.

Equilibrium (reversible) and spontaneous (irreversible) changes.

P-V-T relationships for non ideal gases. Development of Equation of State; VLE with Cubic Equation of state, thermodynamics of Phase Equilibria; Gibbs Deuham Equation; Chemical Potential; Activity Coefficient; Fugacity and Fugacity Coefficient; Excess Gibbs Free Energy, Phase Equilibrium at low to moderate pressure; Ideal and Non-Ideal Solutions; Residual and Excess property relation; Heat Effects.

Thermodynamics applications & calculations in gas, vapor & combine power cycles, Heat engines, Turbines, Steam turbine, Gas turbine, Compressors. Applications of thermodynamics to flow processes.

Thermodynamics analysis of Steady state & unsteady state processes.

CH-507: Thermal Process Engineering

Optimal design of shell and tube heat exchangers. Pinch technology. Flow arrangements of increased heat recovery. Condensation of single vapors, condensation of single and mixed vapours. Vaporizers, evaporators and reboilers. Extended surfaces heat transfer, cooling towers, furnace design and operation. Process design of equipment of heat transfer operation based on performance and economic optima

CH-508: Process Design Simulation

Introduction to chemical processes. General Design Factors and Specifications; Rules of thumb in design; Materials of construction, flow sheeting.

Process modeling (modeling principle and basic modeling), simulation and analysis techniques; (Gauss-sidle, Gauss Jacobi, R-K method, Newton Raphson method etc.).

Engineering economic analysis of chemical processes; financial management.

Strategies for decision making; Pinch analysis. Introduction to Aspen energy analyzer.

CH-509: Reactor Design and Kinetics

Isothermal Reactors; Non-Isothermal Reactor; Batch, Tubular and Stirred Tank Reactors; Stable Operating Conditions in Stirred Tank Reactor; Non-Ideal Reactors; Residence Time Distribution; Conversion Models in Non-Isothermal Reactors. Catalysis and Adsorption; Solid Catalysts; Preparation and Classification of Catalysts; Surface Area, Density and Void Volume of Catalysts; Rate Equation of Fluid-Solid Catalytic Reactions. External Transport Processes in Heterogeneous Reactions; Fixed Bed and Fluidized Bed Reactors; Internal Transport Processes; Reaction and Diffusion in Porous Catalysts; Effectiveness Factors; Interpretation of Experimental Data from Laboratory Reactors; Design of Heterogeneous Reactors.

Biochemical Reaction System, Enzyme Fermentation, Michaelis-Menten Kinetics (M-M Kinetics), Batch Or Plug Flow Ferment or, Mixed Flow Ferment or, Inhibition By A Foreign Substance-Competitive And

Noncompetitive Inhibition.

CH-521: Process Dynamics and Control

Development of Process Models; Dynamic Behavior of Linear Systems; Frequency Analysis; Stability Analysis; Feedback Control Systems; Cascade, Feed-forward and ratio control; multivariable system; cascade control; over-ride control; selective control; Dead time Compensation, inferential control, adaptive control; Multi-input and output systems – process and control loop interactions, discrete time models, closed loop analysis, digital control system implementation.

Sensors, Transmitters, and Transducers, Static and Dynamic Characteristics, Final Control Elements, Control Valves, Valve Positioners, Specifying and Sizing Control Valves, Accuracy in Instrumentation, Calibration of Instruments, Dynamic Measurement Errors.

CH-522: Advanced Refining and Gas Engineering

Introduction; Overall Refinery Flows; Refinery Products; Refinery Feed Stocks; Petroleum Composition; Crude Distillation Curves. Crude Distillation; Desalting; Atmospheric and Vacuum Distillation. Lubrating oil blending.

Introduction to natural gas industry; gas production. Testing of well fluid; Test separator, Multiphase flow meters, establishing GOR; Gas-liquid separation - Design and configurations. Dehydration of Natural Gas, LPG recovery and condensate stabilization. Gas processing facilities, process flow schemes and product specifications.

Investment and Operating Costs.

Cost estimation, Rule-of-Thumb Estimates, Cost-Curve Estimates, Major Equipment Factor Estimates, Definitive Estimates, Storage Facilities, Land and Storage Requirements, Steam Systems, Cooling Water Systems, economic evaluation, Return on Original Investment, Case-Study Problem: Economic Evaluation.

CH-523: Process Safety Management

Overview: Chemical process accidents.

Process Safety-related Standards and Regulations

Process Safety Management System (PSM)

Toxicology:

Toxic Release and Dispersion Models:

Hazard Identification & Control:

Permit to work systems (PTWs).

Fires and Explosions

Accident Presentations

Risk and Reliability:

On-site risk, Fatal Accident Rate (FAR), Off-site risk

Individual and societal risks, Quantitative risk assessment methods, Event tree analysis, Fault tree analysis

Bow tie analysis

Investigation Methodologies

Determining Root Causes, Structured Approach Developing Effective Recommendations.

Accident Investigation & Reporting:

Learning from accidents, Investigation process and reporting.

Case studies.

CH-524: Business Writing and Communication

Purpose of Effective Writing,

Different styles of correspondence and templates, business letters, business cases, minutes and agendas, Writing for a purpose, planning.

Plan for Writing template formulate a plan for a new idea.

Ensuring professional documents.

Writing Powerful and Engaging Sentences. Creating Logic and Flow.

Common Business Language Reviewing and proofreading styles and standards

Report Writing, purpose, planning, structure

Initiatives Management Process. Representing Data Visually. Referencing Styles.

Common abbreviations, quotations and admitting biases, quick tips. Rheological strategies used in various forms of written and oral business communication, Verbal and non-verbal forms of communication appropriate to the business environment. Research article writing.

Group discussion, Draft a brief report.

CH-498: Fundamental of Chemical Engineering

Rate of reaction, variables affecting the rate of reaction, order of reaction, rate constant; searching for a mechanism of reaction, activation energy and temperature dependency, Interpretation of batch reactor data for single and multiple reactions. Integral method and differential method of analysis for constant volume and variable volume batch reactors Search for a rate equation. Design of homogeneous and heterogeneous reactors, Batch, mixed flow, Plug flow reactors, Determination of rate controlling steps, Catalysis desorption Isotherms, Kinetics of solid catalyzed reactions.

Incentives for chemical process control. Feedback and feed-forward of dynamic processes. Linearization of nonlinear systems. Laplace transforms. Solution of linear ordinary differential equations using Laplace transforms. First-order systems, second-order systems, higher-order systems, time delays, inverse response systems, transfer functions.

Conduction: Steady state and Unsteady state, Fourier's law, thermal conductivity, one and two dimensional analysis; Convection: Free and force convection, convection in laminar and turbulent flows, flows over flat plate, inside ducts and tubes. Radiation: Laws of Radiation, Radiation surface behavior and shape factor for black body and non-black body radiation Heat transfer equipment, types and selection criteria.