المحتوى العلمي للمقررات الدراسية للهندسة الكيميائية
Description of Course Content for Chemical Engineering

CHE 200 Physical Chemistry (3 Units):
Prerequisite: GS131

Thermodynamics: The first law of thermodynamics, thermochemistry, second law of thermodynamics and thermal engine, entropy calculation and the third law of thermodynamics. Work and free energy and equilibrium – application of thermodynamics to Homogeneous and Heterogeneous systems equilibrium constant , the general characteristics of ideal solution. Electro chemistry: Conductivity – Electrolyte – galvanic and fuel cells, electrode potential, Nernst equation, the change in free energy – cell potential and half-cells. Reaction rate: nature of reactants, concentration of reactants, Temperature and catalysis, energy diagrams for chemical reactions, degree of reaction and chain reactions.

CHE 201 Physical Chemistry Laboratory (1 Unit): Prerequisite: CHE200

Experiments on thermochemistry: Calorimetry and Bomb calorimetry. Pure liquids and solutions: Distillation of binary mixtures, incomplete miscibility, Distribution between immiscible solvents, Electrolytes and electrochemical cells. Chemical kinetics.

CHE 210 Introduction to Chemical Engineering (3 Units)
Prerequisite: GS121

Nature and scope of chemical industry. Concept of unit operation and unit processes. General concepts of chemical engineering, functions of a chemical engineer. Presentation and correlation of data. Useful mathematical and graphical tools. Units and unit conversions, process variables like temperature, pressure, density, etc. Stoichiometry, Material balances involving by – pass, recycle and purge. Material balances for unsteady state processes. The general energy equation.

CHE 211 Chemical Engineering Calculations (3 Units)
Prerequisite: CHE210

Application of the energy balance for systems with and without phase change, enthalpy changes accompanying chemical reactions. Combined material and energy balances. Thermochemical calculation, Thermochemistry of solution and mixing processes. Enthalpy – concentration diagrams and humidity chart. Combustion calculation for solid, liquid and gaseous fuels. Energy balances for industrial processes.

CHE 212 Chemical Engineering Thermodynamics I (3 Units) Prerequisite: CHE200

Basic concepts: properties of a system. Work, energy and heat. First law of thermodynamics and its applications: Thermodynamic processes: Constant volume, Constant pressure. Isothermal and polytropic processes. Reversible and irreversible

processes. Compression of an ideal gas. Second law of thermodynamics: Entropy changes for various processes. Energy conversion processes: Carnot cycle, heat engines, Vapor power cycles, internal combustion engines and jet engines. Refrigeration cycles: vapor compression and absorption refrigeration.

ME 201 Strength of Materials (3 Units):
Prerequisite GE 140

Introduction - Direct Stresses: Tensile and Compressive Stresses - Stress-Strain Relations - Hook's Law -Factor of Safety - Poison's Ratio - Strain Energy – Resilience - Toughness -Composite Stresses - Thermal Stresses -Shear Stress and Shear Strain - Modulus of Rigidity -Shear Strain Energy - Relations Between Young's Modulus, Modulus of Rigidity, Poisson's Ratio, and Bulk Modulus of Elasticity - Bearing Stress -Thin Shells under Internal Pressure - Shearing Force and Bending Moments of Beams, Shearing Force and Bending Moment Diagrams - Moment of Inertia of Areas - Torsion: Torque, Torsion of Circular Shaft, Comparison in Torsion of Solid and Hollow Shaft - Bending Stresses - Buckling of Columns.

CHE 301 Industrial Organic Chemistry (2 Units):
Prerequisite: CHE 200

Nitration Processes, Nitrating agent – Aromatic Nitration – Mechanism of aromatic nitration – Nitration of paraphilic hydrocarbons, Halogenations (Chlorination), Chlorination agent – Type of chlorination reactions, Substitution Reactions, Addition Reactions, Oxidation Processes, Oxidation Agent- Types of oxidation reactions, Oxidation in Liquid phase, Oxidation in Gas phase, Sulphonation processes, sulphonation agent – aliphatic compounds sulphonation –aromatic compounds sulphonation, esterification processes, esterification by organic carboxylic acids – esterification by organic carboxylic acids derivatives, amination processes, amination agent, hydrogen substitution – sulphuric group substitution, changing alcohols to amines – changing the carbonyl compounds to amines, polymerization, addition polymerization – condensation polymerization, petrochemicals, amine manufacture – methanol – urea – ethylene and acetylene manufacture, hydrocarbons manufacture – aromatic compounds manufacture.

CHE 302 Analytical Chemistry & Instrumentations (3 Units): Prerequisite: CHE 200

Introduction: Errors and estimations of errors, Classifications of Chemical analysis and concentrations of solutions by different methods. Volumetric analysis. Gravimetric analysis and Oxidation-reduction reactions. The effect of electromagnetic rays on materials. Electromagnetic rays. Separation of long waves rays. Measurements of rays energy. Measurement of electrical and electronic circuits used in instruments. Study of phase analysis of atoms. Atomic absorption. Atomic radiation fluorescence radiation. Atomic absorption equipment & radiation fluorescence equipment. Absorption spectrum, atomic spectrum and UV spectrum and visible spectrum. Qualitative analysis using spectral data . Quantitative analysis. Spectral analysis of absorption I.R theory of I.R the I.R rays spectra equipment. Analysis equipment of N.M.R and equipment. Mass spectrum. Analysis by chromatography. Paper chromatography and column chromatography. Electrochemical methods: Conductivity, Potentiometer and Photometry, Refractive index and Refractometer.

CHE 303 Industrial Organic Chemistry Laboratory (1 Units):
Prerequisite: CHE 301

Experiments on various aspects of the organic industrial processes such as industrial synthesis based on petrochemicals, and organometallic reactions of industrial interest.

CHE 304 Analytical Chemistry & Instrumentations Laboratory (1 Units) Prerequisite: CHE 302

Analytical Chemistry: Analytical spectroscopy, Chromatographic Methods, Thermal and Electrochemical of Analysis, Environmental Analytical chemistry.

Instrumental analysis: Chromatographic instrumentation, Atomic absorption, mass spectrum, spectroscopic and electroanalytical techniques. Practical application on the instruments used for quantitative analysis, different calibration methods, types of instrumental methods, reaction and galvanic cells, potentiometer.

CHE 313 Chemical Engineering Thermodynamics II (3 Units) Prerequisite: CHE 212

PVT properties of real gases. Equations for thermodynamic properties in terms of PVT properties. Generalized correlations of PVT and thermodynamic properties of real gases. PVT properties of mixtures of real gases. Ideal and real solutions. Partial molar properties and chemical potential. Fugacity and fugacity coefficients. Standard states. Activity and activity coefficients. Heat of mixing and solution. Phase equilibria = Vapour–liquid equilibria of binary systems at ordinary pressures. High-pressure equilibrium. Critical and retrograde phenomena. Calculation of bubble and dew points. Estimation of K value using various methods. Chemical equilibria: effects of temperature and pressure on equilibrium constants. Equilibrium conversion in chemical reactions. Study of feasibility of a chemical reaction.

CHE 314 Numerical Method in Chemical Engineering (3 Units) Prerequisite: GS 222, GS 228

Solution of linear equation (Gauss elimination methods, iterative methods, Solution of nonlinear equation (Iterative methods, the approximate method, Newton's – Raphson method). Interpolation (Difference tables, Newton's interpolation formula, Sterling's formula, Lagrange's method. Numerical differentiation (Approximation of derivatives, formulas for numerical differentiation), Numerical integration (Simpson's rules, Trapezoidal method, Romberg's integral) Numerical Solution of initial value differential equations (Euler's method, Picard's method, Rung-Kutta methods), Finite difference method for boundary value differential equations, elliptic equations and parabolic equations.

CHE 320 Fluid Mechanics I (3 Units)
Prerequisite: CHE 210

Fluid proprieties and definitions – shear force and shear stress. Newtonian and non – Newtonian fluids. Viscosity and momentum transfer, Units and dimensions. Fluid static – Hydrostatic equilibrium. Pressure variation in static and incompressible fluid, Manometers, Force on plane area, buoyant force. Flow patterns, Energy relationships.

Venture and orifice meters, rotameter, Pitot tube, weirs and notches flow meters. Energy losses in pip line flow, friction factor chart. Boundary layer concepts. Momentum equation applied to the boundary layer. Laminar and turbulent boundary layers. Boundary layer separation. Drag on immersed bodies. Steady state open channel flow. Dimensional analysis. Dimensionless groups and their significance. Buckingham II – Theorem.

CHE 321 Fluid Mechanics II (2 Units):
Prerequisite: CHE 320

Pumps, Different types and selection for various application. Pumping of liquids, NPSH, Pump performance characteristics. Flow of compressible fluids. Flow through a constriction. Sonic velocity in fluids, Compression and Compressors. Fans and Blowers. Non – Newtonian fluids, time dependent and time independent Non – Newtonian fluids, Viscoelastic fluids. Flow of general time, Independent Non – Newtonian fluids in pipes. Equation for pressure Drop Calculations. Agitation and Mixing, Classification of Mixing equipment. Propeller and turbine mixer. Mixers for powders and pastes. Power requirements for mixing. Tow – Phase flow in pipes. Flow patterns for gas liquid flow. Lockhart and MARTINELLI model and other models.

CHE 322 Unit Operations of Particulate Systems (2 Units):
Prerequisite: CHE 320

Particulate systems and the Chemical Industries – Properties of solid masses (Shape, Size and Density). Screen analysis, Calculation based on screen analysis (Specific surface area, Particle size distribution), Storage of solid masses, flow of granular solids. Comminuting and size reduction of solids, Power requirements size reduction equipment. Fluid flow through packed beds of solids, fluidization and its applications. Filtration: Filtration equipment and theory. Motion of solid particles in fluids. Free Settling, Hindered Settling, and Centrifugal separation of solids from gases, and liquids, Thickeners, Cyclones, Electrostatic precipitators.

CHE 323 Heat Transfer I (3 Units):
Prerequisite: CHE 210

Modes of heat transfer and basic equations, conductions law, steady state conduction in one-dimensional system. Heat Transfer from walls and pipes, composite walls and tubes. Insulation. Convection: Forced convection, laminar and turbulent flow heat transfer inside and outside tubes and tube banks, effect of geometry, thermal boundary layers. Dimensional analysis, the use of dimensionless groups. Empirical and practical relations for convection heat transfer. Natural convection. Heat Transfer with change in phase, boiling, condensation heat transfer, estimation of heat transfer coefficient. Double pipe heat exchanger and the log mean temperature difference (LMTD). Radiation: Laws of radiation, Stefan Boltzmann, Kirchhoff and other laws of radiation. Radiation emissivity, absorptivity, black and grey body radiation. Radiation shape factors. Radiation exchange between grey bodies. Electrical network analogies.

CHE 324 Heat Transfer II (2 Units):
Prerequisite: CHE 323

Three-dimensional heat transfer by conduction, unsteady state heat transfer; Schmidt method, Transient heat flow, lumped heat capacity method. Transient heat flow with convection boundary conditions. The use of Heisler charts. Shell and tube heat exchangers, their types and constructional features. LMTD corrections. Fouling factors and the overall heat transfer coefficient; evaporators and condensers. Heat exchanger effectiveness & design. Extended surfaces; type and use of extended surfaces for heat dissipation; regular and irregular fins.

CHE 325 Mass transfer I (3 Units): Prerequisite: CHE 211

Mass Transfer Operations and their classification. Molecular Diffusion in fluids: Flicks law, Equimolar Counter Diffusion through stationary fluid, Diffusion Coefficients, for gas and liquid systems Eddy (Turbulent) Diffusion. Mass Transfer Coefficients, Mass transfer theories, Interphase Mass Transfer and Overall Mass Transfer Coefficients. Humidification, Psychrometric charts, adiabatic saturation chambers, and Cooling Towers. Drying: drying time calculation, factors effecting drying rate, equipment used in drying operations. Adsorption and Ion Exchange: General principles, and equilibrium, equipment used. Crystallization: Types of crystals, equilibrium solubility, yields and Heat and Material Balances. Crystallization Theory, Equipment used.

CHE 326 Chemical Engineering Laboratory I (2 Units): Prerequisite: CHE 321, CHE 324

Experiments on pressure drop across valves, Friction loss in pipe, Friction loss in bends and elbows, Type of flow by Reynolds Number, Entry/ Exit and Contraction / Expansion losses.

Experiments on loading point characteristics in Centrifugal pumps, Operating point characteristics in Centrifugal pumps, Characteristics of Centrifugal pumps in series and in Parallel, Cavitation in Centrifugal pumps, Compressed air temperature at different pressures, Temperature measurement of cooling water and amount of extracted energy (temperature). Conduction: Determination of thermal conductivity for Solid, Liquid and Gas. Determination of Fin efficiency. Convection, Determination of temperature transfer in a pipe flow (Laminar and Turbulent). Radiation: Determination of Radiation Constant

CHE 340 Chemical Technology (3 Units):
Prerequisite: CHE 301

Introduction to chemical process technology. Importance of flow sheets and unit operations and processes. Process details and flow sheets with special reference to the equipment. Operation conditions and modern technological changes involved in the industrial manufacture of selected chemicals, such as minerals acids, caustic soda, and chlorine, industrial gases such as H_2, O_2, CO and CO_2. Ammonia, Nitric acid, Urea, Methanol, Cement and glass. Soaps and detergents. High molecular compounds, general information and production methods. Introduction to the manufacture of some fertilizers

CHE 415 Mathematical Methods in Chemical Engineering (3 Units) Prerequisite: CHE 314, GS 223

Formulation of the engineering problems: Mass and Energy Balances, flow systems, unsteady – state operations, boundary conditions, etc. Solution of ordinary differential equations, series and numerical solutions of ordinary differential equations, applications to heat transfer, mass transfer and fluid flow. The Laplace transforms and its application to Chemical Engineering Analysis of stage wise processes by finite differences with application to Extraction, CSTR systems, Distillation, Absorption, etc. Numerical solution of partial differential equations: linear algebraic equations and elementary properties of matrices, linear programming, and some problems in stage wise operations and optimization, other optimization techniques.

CHE 426 Mass Transfer II (3 Units) Prerequisite: CHE 325

Physical absorption of gases, gas liquid equilibria, absorber calculations, influence of gas and liquid flow rate on absorber calculations. Height of a Transfer Units (HTU) and Number of Transfer Units (NTU). Distillation: Vapour – liquid equilibria, relative volatility, differential distillation (Rayleigh Equation). Flash vaporization, fractional distillation of binary mixtures, estimation of reflux and stage requirements, multiple feeds and side streams. Introduction to Azeotropic, extractive and multicomponent distillation. Extraction: Liquid – Liquid Equilibria, estimation of stage requirements for co-current and counter – current extraction processes. Extraction equipment. Leaching: Dissolving of solids and Liquids. Counter – Current Washing of Solids. Equipment for Leaching.

CHE 427 Chemical Engineering Laboratory II (2 Units) Prerequisite: CHE 322, CHE 426

Experiments on bench scale: Refractive Index, Differential distillation, Distillation with total reflux, Thermal drying oven, packing materials, Humidity measurements.

Experiments on the properties and handling of particulate solids: Crushing and grinding of solids, Sieve analysis of particulate solids, and movement of particulate solids in fluids. Experiments on operations involving particulate solids: Classification, Sedimentation, Centrifugation, Filtration.

CHE 430 Chemical Reaction Engineering I (3 Units) Prerequisite: CHE 313

Introduction, Interpretation of chemical reaction and reactor design data. Technical chemical kinetics, thermodynamics, and reaction engineering. Kinetics of homogenous chemical reaction, reaction rate, fundamentals of chemical kinetics, reaction order, stoichiometric coefficients, reaction mechanism, reaction rate constant. Temperature and reaction rate constant. Arrhenius equation. Establishing rate equations from theoretical data. Reaction rate equation analysis. Irreversible simple reaction, reversible simple reactions. Analysis of reaction rate equation for complex chemical reactions. Introduction to chemical reactor design – performance equation for the batch reactor, performance equation for the continuous reactor, (TPFR) and Mixed Flow Reactor.

CHE 431 Chemical Reaction Engineering II (2 Units)
Prerequisite: CHE 430

Design of Homogenous Chemical reactors: Batch Reactor continues Reactor. Mixed flow reactor, Tubular plug flow Reactors, comparison of performance for MFR and TPFR and Bach reactors for single Chemical Reaction. Multiple Reactor systems: TPFR in series and in parallel, Effects of Temperature and pressure on reactor design, Residence time distribution recycled chemical reactors. Reactor type and size for auto catalytic Reactions. Reactor design for Heterogeneous reactions. Parameters influencing the performance of Heterogeneous reactions. Types of Heterogeneous reactors, Fixed bed, Fluidized bed and slurry reactors.

CHE 442 Petroleum Processing (2 Units) Prerequisite: CHE 340

Petroleum as a source of fuel and lubricating oils, World tends towards the utilization of petroleum as a source of Chemicals. Chemical and physical characteristics and classification of crude petroleum and its products. Crude preparation. Introduction to processing, refinery and distillation processes, tube still heaters, heat exchangers, and towers. Solvent extraction, dewaxing and blending of lubricating oils. Natural and refinery gases. Conversion processes: Thermal cracking, cracking and reforming, isomerization, alkylation and polymerization. Reactors for conversion processes.

CHE 443 Petroleum Processing (1 Units) Prerequisite: CHE 442

Testing of crude Oil and products: Viscosity, Pour point, Smoke point Flash point, Annealing point Colour test, Specific gravity and API, Sulphur content, Water content by Dean & Stark, Ash content, Sediment content, Penetration test, Foam test, ASTM Distillation, Gum formation, Asphalten content & Oxidation stability.

CHE 450 Chemical Engineering Plant Design I (3 Units) Prerequisite: CHE 324, CHE 325

Plant locations: site plans and layout. Flow sheet: Symbols, calculation and information to be shown on the flow sheet. Piping and instrumentation diagrams: Pipe design types and specifications for fitting, valves and pressure relieving devices. Single and piping diagrams and pipe – line networks. Cost considerations involved in plant, equipment and products. Estimation of total product cost. Depreciation, Profitability evaluation and alternative investments.

CHE 451 Chemical Engineering Plant design II (3 Units) Prerequisite: CHE 450

Optimum Design: Equipment selection, specification and design of materials transfer. Handling and treatment equipment: pipes, Pumps, Ejectors for vacuum systems, separation of solids, liquids and gases.

Equipment selection, Specification and design of heat transfer equipment: Heat exchangers. Equipment selection and design of Mass transfer equipment and reactor: Distillation Columns, Absorption columns and reactors.

CHE 452 Engineering Materials (3 Units) Prerequisite: ME 201

Mechanical properties of materials. Metallic materials: Carbon and low – alloy steels, high alloy steels, Nickel and alloys, Aluminium and alloys. Special metals: Titanium, Tantalum and Zirconium. Fabrication Techniques for metals and alloys. Ceramics, Plastics and composites. Organic and metallic coatings. Cost considerations and materials selection for process equipment.

CHE 453 Process Equipment Design (3 Units) Prerequisite: CHE 452

Metals: Properties and specifications, low and high temperature materials, material selection. Equipment Design: Pipe Design: Optimum pipe size selection by least annual cost, Pressure drop available and velocity allowable. Vessel classification. Pressure vessel codes and standards, reasons for vessel failure, design of thin wall cylindrical and spherical vessels under internal pressure, design of heads and closures, compensation for openings and branches, design of process vessels under external pressure, design of tall vertical vessels under combined loading, vessel supports, flanges and gaskets, design of liquid storage tanks, mechanical design of heat exchangers, vessel internal and expansion joints. Introduction to high-pressure vessels including multi-layer vessels.

CHE 460 Process Instrumentation (2 Units) Prerequisite: CHE 321, CHE 324

Introduction: Properties of measuring instruments, (calibration, Precision, errors). Techniques for measuring various variables: Temperature, pressure, vacuum, flow, level and viscosity. Recording, Control and alarm devices. Process instrumentation and control flow diagram. Symbols and Numbers of various instruments used in Chemical processes. Description of various types of process variables. Controllers: Level controller: Fisher 2500 – 259 - Pressure Controller: Fisher wizard I 1400 V- Fisher wizard II 4150- Fisher wizard II 4160.

CHE 461 Process Dynamics and Control (2 Units)
Prerequisite: CHE 460

Introduction: System analysis, control loops, control diagrams, classification of controller action, automatic versus manual control. Laplace transfer and transfer function, Linearization of non-linear systems, dynamic response of first order and second order systems, lag and dead time systems with distributed parameter. Controller action: Proportional, integral, differential and PID controller. Response of different controller types. System stability: Systems analysis using frequency response, introduction, Bode diagram, stability test using Bode diagrams, Nyquist diagrams, stability criteria.

CHE 462 Chem. Eng. Laboratory III (2 Units) Prerequisite: CHE 431, CHE 461

Experiments on batch reactor, continuous stirring tank reactor, plug flow reactor and series continuous stirring tanks reactor. In addition, experiments on control process for packed and plate Distillation towers, temperature of the plug flow reactor.

CHE 542 Petrochemical Technology (3 Units)
Prerequisite: CHE 442

Introduction to petrochemical industries, natural and refinery gases, naphtha and liquid hydrocarbons as raw material for the petrochemical industry, separation process for light hydrocarbons. Technology of individual chemical products, methane- based chemicals: Acetylene, vinyl chloride, carbon black, synthesis gas for ammonia and methanol, formaldehyde from methanol. Olefin- based chemicals: separation methods, production and uses of ethanol, ethylene oxide, vinyl chloride, and ethylene chloride.

Aromatic- based chemicals: Benzene based chemicals, Styrene, chlorobenzene, Phenol and Acetone. Polyethylene, Polystyrene, Poly vinyl chloride, Acrylonitrile, styrene-butadiene rubbers.

CHE 554 Process Modelling and Simulation (3 Units) Prerequisite: CHE 426, CHE 451

Methods of analysis, modelling and simulation of the process equipment, also integrated operations in the cases of continuous and batch operations. The application of mathematical, analytical and numerical methods in selected cases.

CHE 599 Engineering Project: Continue, Prerequisite: All CHE Courses

Project course work is intended to reinforce the training of the students in applying knowledge acquired from the different courses earlier or to solve specific industrial problems. The students may be assigned to a topic on the design of the process unit involving process flow sheets, material and energy balances, detailed design calculation for at least one important equipment, cost estimation and design drawings. The students will be required to submit the final project report containing the above details.

CHE 570 Industriel Management (2 Unît)
Prerequisite: CHE 450

Principles of management, function of management, industrial organization and management techniques, research and development, procurement and contracting, production and marketing, personnel and administration, financial matters, Motivating others and developing subordinates, Specialized management functions associated with the chemical industry.

CHE 571 Safety and Loss Prevention (2 Units)
Prerequisite: CHE 442

Nature of chemicals, petroleum and fertilizer industries and problem associated with processing and handling of different types of materials in these industries. Precaution of Loss prevention approach, hazards associated with materials such as toxicity, flammability and reactivity. Process hazards associated with deviation from pressure, temperature, flow level, reactions, leakage, noise, fire and explosion. Ignitions sources. Identification and assessment of hazards check lists and fault trees, fire and explosion index and its application and estimation. Contaminant and control of hazards, Consideration of plant location, lay out and design, over pressure protection, pressure releasing devices, plant modifications, and safety in electrical systems.

CHE 544 Seminar (1 Unit):
Prerequisite: ---

Presentation of research topic on a chemical industry or related operation.

CHE 599 Engineering Project II (4 Units) Prerequisite: Passing 124 Units

Project course work is intended to reinforce the training of the students in applying knowledge acquired from the different courses earlier or to solve specific industrial problems. The students may be assigned to a topic on the design of the process unit involving process flow sheets, material and energy balances, detailed design calculation for at least one important equipment, cost estimation and design drawings. The students will be required to submit the final project report containing the above details.

CHE 572 Plant Utilities (2 Units) Prerequisite: CHE 451

Water: Industrial and municipal water, uses and specifications, Water conditioning and reuse, water treatment methods, ion exchange, precipitation processes, water desalination, demineralization. Energy and Fuels: Liquid fuels, gaseous fuels, and natural gas, L.P.G. Steam: Steam as a heat transmission medium, other application of steam, boilers efficiency, Power generation, electric power from steam, other possible sources of energy. Air: compressed air as a general plant utility and as a source of instrument systems. Refrigeration system.

CHE 573 Corrosion Engineering (3 Units)
Prerequisite: CHE 452

Introduction to corrosion, corrosion definition, corrosion system, corrosion consequences, corrosion forms, factors that affect corrosion, corrosion processes classifications, the electrochemical cell, the electrochemical series (electro-motive series), the electrode potential (half-cell reaction), faradic current, corrosion of metals in contact, corrosion rate determination (different methods). Corrosion prevention (control) (different methods), cathodic protection (CP), inhibitors, calculation of inhibitor efficiency, optimum inhibitor concentration, the classification of inhibitors, factors affecting corrosion inhibitors performance.

CHE 574 Air Pollution Control (3 Units)
Prerequisite: ---

Introduction to pollution, pollution definition, pollution major forms, effects of pollution on environment, Air pollution, Air Quality Index (AQI), air pollution sources, air pollution types and classifications, major air pollutants, Hazardous wastes, waste classification, hazardous waste disposal, pollution control, air quality management, technology used for air pollution control, effect of air pollution on materials, steps to help stop pollution. Energy – Sources, types and important aspects: Introduction to energy sources: How energy is produced and consumed, and ways in which it affects society and the environment. Physical understanding of issues and problems involved with the generation, storage, transport, and usage of various forms of energy in technological society. Types of energy resources as Renewable and Non-renewable energy, fossil fuels

and hydropower, nuclear, solar, and wind energy, and issues related to energy conservation in everyday life. Effects of waste products associated with energy generation, usage, and energy conservation measures.

CHE 575 Water Treatment (3 Units):
Prerequisite: ---

Total Water Management - Hydrologic Cycle, Supply and Demand, Regulations, Watershed Management, Ground and Surface Water, Hydrology. Overview of Water Treatment - Supply Water Characteristics, Water Quality, Drinking Water Standards, Water Chemistry, Chemical Reaction and Kinetics, Water Conveyance and Distribution, Hydraulics. Conventional Water Treatment Processes - Aeration, Sedimentation, Rapid Mixing, Flocculation, Coagulation, Filtration, Disinfection, Fluoridation, Water Softening, Turbidity Removal, Taste and Odor Control

Advanced Water Treatment Processes - Ion Exchange, Ozonation, Adsorption, Ultra Filtration, Membrane Processes, UV Disinfection. Overview of Wastewater Management - Wastewater Characteristics, Flows and Pollutant Loads, Biochemistry and Microbiology, Sanitary and Storm water Collection Systems, Effluent Quality Standards, Receiving Stream Quality, Design Standards, Economic Analysis

Wastewater Preliminary and Primary Treatment Processes - Screening, Grit Removal, Sedimentation

Secondary Wastewater Treatment Processes - Activated Sludge, Trickling Filters, Rotating Biological Contactors, Stabilization Ponds, Lagoons, Aeration, Clarification, Filtration, Chlorination-DE chlorination

Advanced Wastewater Treatment Processes - Chemical Coagulation, Carbon Adsorption, Phosphorus Removal, Nitrogen Removal (Nitrification/Denitrification), Media Filtration, UV Disinfection.

Solids Handling Processes - Gravity Thickening, Flotation Thickening, Dewatering, Pressure Filtration, Stabilization, Aerobic and Anaerobic Digestion, Composting, Drying, Incineration, Landfilling, Land Application.