Al-Nahrain University
College of Engineering
Chemical Engineering Department
Syllabus for B.Sc. Degree Course
2021-2022

First Year
First Semester

1- University Requirements I　　　　　**Th. 1　App. ---　Tut. ----　Units 1**

حقوق الانسان: ماهي حقوق الانسان, فئات حقوق الانسان , خصائص حقوق الانسان , الأهداف المتوخاة
من تحقيق حقوق الانسان , جذور حقوق الانسان وتطورها التاريخي , حقوق الانسان في حضارة وادي الرافدين
, حقوق الانسان في الحضارات القديمة الاخرى: الهندوسية / الصينية / الفرعونية/ الأغريقية , حقوق الانسان
في الاسلام , حقوق الانسان في العصور الوسطى , حقوق الانسان في العصر الحديث , الاعلان العالمي لحقوق
الانسان عام 1948 , حقوق الانسان في المواثيق العربية والدولية , ملخص الحقوق من الاتفاقية الدولية الخاصة
بحقوق الطفل الصادرة عام 1989 والبروتوكولان الملحقان بها عام 2000 , كيف الوصول الى خلق مجتمع
يسوده السلام والمحبة واحترام حقوق الانسان .

2- Computer Fundamentals and Programming I **Th. 1　App. 2　Tut. ---　Units 2**
   Introduction to Computer Systems, Architecture, Organization, and Languages.
   Arithmetic Operations and Library Functions.
   Algorithm and Flowchart.
   Decision Making.
   Program Loops
   Engineering Applications.

3- Mathematics I　　　　　　　　**Th. 3　App. ---　Tut. 1　Units 3**
   Prerequisites for Calculus: Coordinates and Graphs in the Plane, Slope, and
   Equations for Lines, Functions and Their Graphs, Shifts, Circles and Parabolas,
   Trigonometric Function, Absolute Values and Target Values.
   Limits and Continuity: Limits, The Sandwich Theorem and $(\sin\theta)/\theta$, Limits
   involving Infinity, Continuous Functions, Defining Limits Formally with Epsilons.
   Derivatives: Slopes, Tangent Lines and Derivatives, Differentiation Rules,
   Velocity, Speed and other Rates of Change, Derivatives of trigonometric Functions,
   Chain Rule, Implicit Differentiation and Fractional Powers, Linear Approximations
   and Differentials, Newton's Method for Approximating Solutions.
   Applications of Derivatives: Related Rates of Change, Maxima, Minima and the
   Mean value Theorem, Curve Sketching with y' and y", Graphing Rational
   Functions-Asymptotes and Dominant Terms**,** Optimization, Antiderivatives, Initial
   Value Problems and Mathematical Modeling.
   Integration: Calculus and Area, Formulas for Finite Sums, Definite Integrals,
   Fundamental Theorems of Integral Calculus, Indefinite Integrals, Integration by
   Substitution, Numerical Integration, Introduction to Logarithms Exponentials.
   Applications of Definite Integrals: Area between Curves, Volumes of solid of
   Revolution, Cylindrical Shells, Lengths of Curves in the plane, Areas of Surfaces of
   Revolution, Work, Fluid Pressures and Fluid Forces, Centers of Mass.
   The Calculus of Transcendental Functions: Inverse Functions and their
   Derivatives, lnx, e^x and Logarithmic Differentiation, Other Exponential and

logarithmic Functions, Growth and Decay, Indeterminate Forms and l'Hopital's Rule, Rate at which Functions Grow, Inverse Trigonometric Functions, Derivatives of Inverse Trigonometric Functions, Related Integrals, Hyperbolic Functions.

4- <u>Engineering Drawing I</u>　　　　　**Th. 1　App. 2　Tut. --- Units 2**

Introduction to Engineering Drawing: Standards of Drawing Sheets, Types of Lines and Lettering, Use of Drawing Instruments.

Principles of Geometrical Constructions: Straight Line Operations, Curved Line Operations, Tangency Construction, Drawing of Contour Lines of Parts, Dimensioning.

Orthographic Projection: Drawing of Complete Orthographic Projection

Descriptive Geometry: Introduction to Graphical Representation, Projection of Points, Projection of Straight Lines, Determination of True Length of Straight Lines, Determination of Line Inclination with the Main Planes.

5- <u>Work Shop Technology</u>　　　　　**Th. --- App. 3　Tut. --- Units**

Principles of Safety in Workshop and Laboratories:

Cutting: Cutting Tools, Measuring Equipments, Sawing, Drilling, Turning Milling, Grinding.

Welding: Equipments, Arc Welding, Gas Welding, Productive Sample

Electricity**:** Tools and Equipments, Electrical Symbols, Transformers, Electrical Circuit Fundamentals Practices.

Carpentry: Tools and Equipments, Join Half on Half Practice, Cylindrical Shaft Practice, Productive Sample.

Plumbing: Tools and Equipments, Uniform Pentagonal Practice, Joining by Plumbing, Productive Sample.

Filings: Tools and Equipments, Manual Filings, Handsaw, Internal and External Manual Tapping.

6- <u>Analytical Chemistry</u>　　　　　**Th. 2　App. 2　Tut. --- Units 3**

Types of analysis in analytical chemistry and their uses, Expression of concentration and content, Standard solutions, Amounts of reactants and products, Chemical equilibrium, The relation ship between chemical kinetics and chemical equilibrium, Electrochemistry, Gravimetric analysis, Volumetric analysis their uses and classification, Titer metric analysis calculations, Acid-base titrations, Precipitation Titrations, Complex metric titrations, Reduction-oxidation titrations.

7- <u>Principle of Chemical Engineering I</u>　　**Th. 3　App. - Tut. 1　Units 3**

Units and Dimensions, Basis, Temperature and pressure, Physical and chemical properties, Technique of problem solving, Chemical engineering equation and stoichiometry, Material balance without and with chemical reaction, Problem involving tie components, Recycle calculation, Bypass calculation, Purge calculation, Combustion calculation, Ideal gas law, Real gas relations.

8- <u>Physics</u>　　　　　**Th. 2　App. 2　Tut. -- Units 3**

Units, Physical quantities and vectors, Motion along straight line, Average velocity, Relative velocity, Motion in a plane, average and instantaneous velocity, Newton's law of motion and applications, Force, mass and weight, Application of Newton's law I, Application of Newton's law II, Work and energy, Conservation of energy and power, Impulse and momentum.

Department of Chemical Engineering
First Year
Second Semester

1- English Language I   Th. 2   App. --- Tut. ---- Units 2

Reading Comprehension I
Structural Items: Present Simple, Present Continuous, Past Simple, Past Continuous
Present Perfect, Future Simple, Conditional Statements (Types I, II, III), Indirect
Questions, Simple Statements
Definite and Indefinite Articles
Idioms.

2-   Biology   Th. 2   App.   Tut. --- Units 2

- Introduction to Biology.
- Definition of the most important terms.
- The Essential Bio molecules (Macromolecules:
CARBOHYDRATE, PROTEN, LIPID, DNA & RNA).
- Homeostasis.
- The Cell (Prokaryotic & Eukaryotic cells).
- Eukaryotic Cell in details (MEMBERAN, CYTOPLASM,
NUCLIUS).
- The differences among (Virus, Bacteria & human body).
- Gene Expression (transcription & translation).
- Protein Synthesis & RNA Types (mRNA, tRNA, rRNA).
- Cell division (MEIOSIS) & MITOSIS).
- Cell Cycle.
- Transport Across the Plasma Membrane [(passive & active),
Diffusion (Simple & Facilitated diffusion), Types of active
transport].
- CELL DIVISION (MEIOSIS & MITOSIS).
REPRODUCTIVE CELL DIVISION (MEIOSIS).
- Enzymes, Hormones, Vitamins & Minerals in the human body
- Interpretation of Metabolism [Fate of Carbohydrate (glycolysis,
gluconeogenesis, glycogenolysis, glycogenesis), Fate of protein,
Fate of Lipid, Disorder due to error in metabolism such as
(Diabetes, Obesity and BMI, Phenyl ketone urea, Inborn error) ,
Urea, Cori cycle, Cribs cycle.
- The Blood in Human body and their component.
- Fluid in Human body & its compartment.

3- Mathematics II   Th. 3 App. --   Tut. 1   Units 3

Techniques of Integration: Basic Integration, Integration by Parts, Trigonometric
Integrals, Trigonometric Substitutions, Rotational Functions and Partial Fractions,
Using Integral Labels, Improper Integrals.
Infinite Series: Limits, Infinite Series, Series without Negative Terms, Series with
Nonnegative Terms, Alternating Series and Absolute Convergence, Power Series,

Taylor Series and Maclaurin Series.

Plane Curves and Polar Coordinates: Conic Sections and Quadratic Equations, Graph of Quadratic Equations, Parametric Equations for Plane Curves, Calculus of Parametric Equations, Polar Coordinates, Graphing in Polar coordinates, Polar Equations of Conic Sections, Integration in Polar Coordinates.

Vectors and Analytic Geometry in Space: Vectors in the Plane, Cartesian Coordinates and Vectors in Space, Dot Products, Cross Products Lines and Planes in Space, Cylindrical and Spherical coordinates.

Vector-Valued Functions and Motion in Space: Vector-Valued Functions and curves in Space. Derivatives and Integrals, Modeling Projectile Motion, Directed Distance and the Unit Tangent Vector, Curvature, Planetary Motion.

Functions of two or More Variable and their Derivatives: Function of Two or More Independent Variable, Limits and Continuity, Partial Derivatives, Chain Rule, Directional Derivatives and Gradient Vectors, Tangent Planes and Normal Lines, Linearization and Differentials, Maxima, Minima and Saddle Points, Lagrange Multipliers.

4- <u>Engineering Drawing II</u>   Th. 1   App. 2* Tut. --- Units 2

Review of Projection Drawing, Development of Isometric Drawing, Development of Sectional Views, Development of Assembly Drawing.

Computer Aided Draughting:

Introduction to Computer Aided Draughting and Design, Starting and Familiarization with AutoCAD Software, Development of 2D Geometrical Constructions, Dimensions and Comments, Sectioning Techniques, Sheet Layout and Plotting

Descriptive Geometry:

Determination of the Shortest Distance from a Point to a Straight Line in Space, Determination of the Shortest Distance Between Two Straight Lines in Space, Representation of Planes (Methods of Representation), Determination of Planes Inclination Angles, Intersection of Plane, Determination of Points Location on Specific Planes.

 * Engineering Drawing and CAD to be alternatively organized through the semester weeks.

5- <u>Organic Chemistry</u>   Th. 2   App. 3   Tut. --- Units 3

Chemical Bonding in organic compounds, Functional groups and classification of organic compounds, Alkanes and Cycloalkanes, Alkenes, Alkynes, Aromatic compounds, Alkyl halides, Alcohols, Ethers, Aldehydes and Ketones, Carboxylic acids, Salts and Esters of carboxylic acids, Amines, Lipids.

6- <u>Principle of Chemical Engineering II</u>   Th. 4   App. --Tut. 1   Units 4

Vapor pressure, Saturation, Partial pressure and Humidity, Condensation and Vaporization, Concepts and Units of Energy Balance, Heat capacity, Enthalpy changes, Enthalpy changes for phase transion, The general energy balance, Energy balance with chemical reaction, Heat of solution and heat of mixing, Simultaneous mass and energy balance.

7- <u>Mechanics</u>   Th. 2 App. --   Tut. 1   Units 2

Introduction, Definition, Classification, Scalar and Vectors, Force, Types of forces, Basic laws of static, Parallelogram law, Triangle law, Sine law, cosine law, Analysis of forces, Resultant of forces, Inclined surfaces, Moment, Couples, Examples. Equilibrium: Definition, Conditions, Free body diagram, Applications.

Friction: Definition, Theory of friction, Angle of friction, Law of friction, Friction in horizontal surfaces, Friction in inclined surfaces, Applications.

Centroids and Centre of gravity: Centre of flat plate, Centroide using integration method, Centroids of composite areas, Centroids of lines using integration methods, Centroids of composite lines. Moments of Inertia: Definition, Properties, Moment of inertia using integration method, Moment of inertia of composite area.

8- Arabic Language I   **Th. 1 App. -- Tut. -- Units 1**

اللغة العربية: بناء الكلمة (الصرف) , الوحدات الصرفية/ تعريفها، أنواعها

بناء الجملة العربية ونظامها (النحو) : الابتداء ونواسخ

الجملة الاسمية: المثنى والملحق به، الأسماء الخمسة، جمع المذكر السالم، جمع المؤنث السالم , الاعراب ظاهراً ومقدراً ومحلياً , الأسماء المنصوبة/ المفعول به، المفعول المطلق، المفعول فيه ظرف الزمان والمكان، المفعول معه

الأسماء المبنية/ أسماء الاشارة، الأسماء الموصولة، أسماء الاستفهام، أسماء الشرط .

الجملة الفعلية/ بناء الفعل الماضي، بناء فعل الأمر، الفعل المضارع: اعرابه وبناؤه.

الضمائر/ المنفصلة والمتصلة والمستترة (جوازاً ووجوباً) , التطبيقات:

المعجم اللغوي للغة القرآن الكريم , لغة الشعر العربي القديم ,لغة الشعر العربي المعاصر.

Department of Chemical Engineering
Second Year
First Semester

1- English Language II   **Th. 2   App. --- Tut. ---- Units 2**
   Reading Comprehension II,
   Structural Points: Present Perfect, Past Perfect, Present Perfect Continuous,
   Future Continuous, Compound and Complex, Statements
   The Passive Voice
   Prepositions
   Terminology Practices

2- University Requirements II   **Th. 1 App. -- Tut. -- Units 1**

مبادئ الادارة : مفهوم الادارة (تعريفها) , أهمية الادارة في المجتمع , الادارة علم وفن علاقة الادارة بالعلوم الاخرى , عناصر العملية الادارية : التخطيط , التنظيم , التوجيه , الرقابة صفات الاداري الناجح , المشاكل الادارية (تعريف المشكلة، مكوناتها، أنواعها، وكيفية معالجتها). القرار الاداري , السبيل الى إدارة مشروع أو مؤسسة أو إدارة ناجحة , دراسة نماذج من المشاكل الادارية وسبل معالجتها.

3- Arabic Language II   **Th. 1 App. -- Tut. -- Units 1**

النحو: التوابع: النعت، العطف، البدل، التوكيد. الممنوع من الصرف. أفعال المدح والذم. المنصوبات: النداء، الحال، المستثنى بـ(إلا). كتابة العدد: تذكيره وتأنيثه، العدد المركب.

الاملاء: كتابة الهمزة المتوسطة والمتطرفة. كتابة الضاد والظاء. كتابة التاء القصيرة والطويلة.

4- <u>Mathematics III</u>   Th. 3   App. --   Tut. 1   Units 3

Multiple Integrals: Double Integrals, Area, Double Integrals in Polar Form, Triple Integrals in Rectangular Coordinates Volumes and Average Values, Triple Integrals in Cylindrical and Spherical Coordinates.

Matrix Theory: Definition, Properties, System of Linear Equation, Gauss Elimination, Linear Independence and Rank, Determinants, Inverses, Gauss-Jordan Elimination, Matrix Eigen Values Problem, Special Matrices.

Ordinary Differential Equation: Definition, Type, Order, Degree, First order Ordinary Differential Equation (Separable Variable Equation, Homogeneous Equation, Linear Differential Equation, Exact Equation, Substitution Method, Integrating Factor Method, Second Order Differential Equation, Homogeneous Second Order, Non-Homogeneous Second Order (Undetermined Coefficients, Variation of Parameters), Engineering Applications, Third and Fourth Order, Solution of Differential Equation by Series.

Vector Calculus: Scalar and Vector, Components of Vector, Vector Addition, and Multiplication of Vector, Scalar Product, Vector Product, and Line Integral Using Parametric Equation of the Path, Line Integral in Vector Field Work.

Laplace Transform: Definition and Properties of Laplace Transform, Laplace Transform of Different Functions, Inverse Laplace Transform, Using Different Methods, Solution of Ordinary Differential Equations Using Laplace Transformations.

5- <u>Fluid Mechanics I</u>   Th. 3   App. --   Tut. 1   Units 3

Introduction: Physical properties of fluid, Definition of type of fluid (Newtonian, Non-Newtonian, Incompressible, Compressible fluid, Static and Dynamic fluid).
Dimensional Analysis: Rayleigh's method and Buckingham's theorem.
Fluid static and its applications. Fluid Dynamic: Flow pattern and Reynolds number, Bernoulli's equation, correction to Bernoulli's equation, Newton's Law of viscosity and momentum transfer, Boundary Layers.
Flow of Incompressible Newtonian fluid in pipes and channels, Effect of friction, Calculation of friction in straight pipe and fittings, Calculation of pressure drop in straight pipe. Friction from changes in velocity or direction, Velocity distribution for Laminar and Turbulent flow in a pipe.
Flow measurements: Venture meter, Orifice meter, Pitot tube, Area meters, Rotameters, Notch, and weirs.

6- <u>Physical Chemistry I</u>   Th. 2   App. 2   Tut. 1   Units 3

Gas behavior, The kinetic theory of gases, First law of thermodynamics, Thermo chemistry, Second and Third law of thermodynamics, The liquid state (one component system), Solution, Property of dilute solution (collogative properties), Exact and Inexact Differential, Fugacity, Refrigeration, Carnot Cycle.

7- <u>Engineering Materials</u>   Th. 2   App. 2   Tut. --   Units 3

Types of engineering materials, Properties, Tensile, Compression, Hardness,

Impact, Creep, Fatigue, Fretting, Bending, Inter-atomic bonding, Calculations of crystal lattices for BCC, FCC, HCP crystals, Deflects in crystalline structures, Atomic diffusion, Composite materials, Ceramics, Plastics materials, General properties, Types, Stability of plastics materials. Definitions: Alloys, Phases, Constituents, Equilibrium phase diagram, different micro structures, Carbon contents, Cold work effects on mechanical properties, Inspection of micro structure of alloys, Material of Construction.

8- Properties of Petroleum and Natural Gas   Th. 2 App. 3 Tut. Units 3

Crude oil types, Refinery products, Test methods, Physical properties of petroleum and its products, True boiling point curve and other curves.

Introduction of refinery processing, Auxiliary processes and operation, Improve petroleum products, Chemical treatments, Vaporization and condensation, LPG production process, LPG Test and reactions, Petroleum handling and storages, Thermal cracking and decomposition, Natural and refinery gases, Petroleum combustion and heat evaluation. Refinery flow sheet, Straight run Gasoline and treatment to get high octane number.

9- Pollution   Th. 2 App. -- Tut. 1 Units 2

Types of pollution, Water pollution, Inorganic water quality parameters, Organic water quality parameters, Organic materials in water, Naturally occurring organic contaminants, Synthetic organic contaminants, Determination of organic content of water, BOD, COD, TOC, TOD.

Five day BOD Test, Modeling BOD as a first order reaction, The BOD reaction rate constant, Nitrification.

Drinking water standards, water Treatment processes, waste water characteristics and effluent standards, Eutrophication, Industrial waste water. Waste water Treatment processes, The effect of oxygen- demanding waste on rivers, Air pollution, Criteria pollutants, Properties and pollution, Significance of criteria pollutants. Air pollution control, Particulate control, Settling chamber, Cyclone, Separator, Electrostatic precipitator, Fabric Filter, Scrubber and their efficiencies

Department of Chemical Engineering
Second Year
Second Semester
1- University Requirements III   Th. 1   App. --- Tut. ---- Units 1

الديمقراطية: الديمقراطية ـ تعريفه , التطور التاريخي والفكري للديمقراطية في المجتمع , الديمقراطية في نظام الحكم الاسلامي , الديمقراطية في الفكر السياسي المعاصر , خصائص الديمقراطية , نماذج الديمقراطية , أركان الديمقراطية , الانتخابات , أهمية الديمقراطية في المجتمع , مزايا الديمقراطية , عيوب الديمقراطية , عوائق تطبيق الديمقراطية في العراق , أشكال الحكومات
الحريـة: مفهوم الحرية (تعريفها) , الحرية في الاسلام والأديان الأخرى
أنواع الحرية: الحرية الذاتية. الحرية الطبيعية. الحرية الشخصية. الحرية المدنية. الحرية السياسي
مفاهيم مناهضة الحرية

2- Mathematics IV   Th. 3 App. --   Tut. 1   Units 3
Fourier series: Periodic Functions, Fourier Series of Functions with Period 2TI, Fourier Serious of Arbitrary Periodic Functions, Odd and Even Symmetry, Engineering Applications.
Fourier Transform: Definition, Properties of Fourier Transform, Fourier Transforms of Any Function, Inverse F.T., Sine F.T., Cosine F.T., Inverse of Sine and Cosine F.T., Examples.
Power Series: Definitions and Classifications, Ordinary Point, Regular and Irregular Singular Point, Solution of Differential Equation Using Power Series, Maclurain Series, Frobenious Method, Bessel Equations, Legender's Equation.

Partial Differential Equations: Solution by Separation of Variables, Laplace Transform, Fourier Transform.

Complex Functions: Complex Numbers, Curves and Regions in the Complex Plane, Limit, Derivative, Analytical Function, Cauchy-Riemaun Equations, Laplace's Equations, Exponential Functions Trigonometric and Hyperbic Function, Logarithm and General Power.

3- <u>Computer Fundamentals and Programming II</u> Th. 1   App. 2   Tut. --   Units 2
Basic of Mat Lab Arithmetic, Compute both derivative and integrals in Mat Lab, Definite integral, Complex numbers, The phase angle in radiant, Matrix, Finding the determinant or the inverse of a matrix, Solve several simultaneous equations, Work with symbolic variables, Polynomials and Rational Functions, Laplace transforms, Laplace inverse transforms, Plotting functions, Plotting data, M.File, Series, Roots Finding.

4- <u>Fluid Mechanics II</u>   Th. 3 App. 2 Tut. 1 Units 4
Pumping of liquid: Calculation of total head, NPSH, Performance, Characteristics curves, Calculation of horsepower, Types of pumps.
Compressible fluid: General equation, Isothermal and adiabatic conditions, work and Compressors, Fans and Blowers.
Mixing: Equipments and Operation, Degree of Mixing, Power curves, Scale-up of liquid mixing
Non-Newtonian fluid: Type of fluid, Calculation of friction, Pressure drop for general time independent in Laminar and Turbulent flow.
Flow through granular bed and packed column, fixed bed and Fluidized bed.

5- <u>Physical Chemistry II</u>   Th. 2 App. 2   Tut. 1   Units 3
Chemical equilibria, Chemical kinetics, Electrolytic conductance, Electromotive force, Surface chemistry, Principles of colloids, Introduction to nuclear and radiation chemistry, Phase Rule, Electrochemistry.

6- <u>Industrial Safety</u>   Th. 2 App. --   Tut. --   Units 2
Hazards, Explosions, Combustion effects, Toxic Materials, Dangerous processes and Operation, Personal mean protection, Equipment to protect the respiratory tact, Fire and Fire - fighting method, Extinguishing action, Extinguishing agents, Chemical plant Hazard and inspection, First Aid, Facts about safety training.

7- <u>Engineering Statistics</u>   Th. 2 App. --   Tut. 1   Units 2
Frequency distribution and histogram, Curves and smooth in Ogives, Mean, Median, Mode, Other measure of central tendency, Root mean square and Arithmetic mean, Standard deviation and Mean deviation, Measure of dispersion and Chalier's Check, Normal approximation to binomial distribution, Poisson multinomial distribution, Data fitting by theoretical distribution, curve fitting and least square method.

8- <u>Electrical Engineering</u>   Th. 1 App. 3   Tut. 1   Units 2
Ohm's law, Power-series networks and Kerchhofs law, Kerchhofs law, Parallel

networks, Series-parallel networks, Nodal analysis-Mesh analysis, Super Position Theorem.

Department of Chemical Engineering
Third Year
First Semester

1- Engineering Analysis I   Th. 3   App. --   Tut. 1   Units 3
Ordinary differential equations, Solution by series, Tabulated functions and definite integral, Laplace transformation and Inverse Laplace transformation, Solution of differential equation using Laplace transformation, Partial differential equations, Finite differences, Matrices (Algebra), Solution of simultaneous using Matrices, Vector Analysis, System of Linear Differential Equations with Applications.

2- Heat Transfer I   Th. 3   App. --   Tut. 1   Units 3
Conduction heat transfer, Forced convection heat transfer, Cross flow heat transfer, Types of heat exchangers, Overall heat transfer coefficient, Fouling factor, Log mean temperature difference, Effectiveness.

3- Mass Transfer I   Th. 3   App. --   Tut. 1   Units 3
Definition of mass transfer, Molecular and convective diffusion, Fick's 1st law for molecular diffusion, Definitions of concentrations, velocities and fluxes, Molecular diffusion in gases and liquid, Diffusion through varying cross sectional area, Maxwell theory: For gases and liquids in binary and multicomponent mixtures, Diffusion coefficients in gas and liquid, Molecular diffusion in solid, Molecular diffusion in biological solutions, Continuity equation and introduction to unsteady state diffusion.
Mass transfer coefficients: Mass transfer coefficient from dimensionless group, Mass transfer for flow inside a wetted wall column, Mass Transfer in flow parallel to flat plates and past single spheres, Theories of mass transfer.
Absorption: vapor-liquid equilibrium, Gases in absorption, Capacity of packed absorption for dilute and concentrated mixtures, Relation between individual and overall height of transfer units, Absorption in plate tower, Non-isothermal absorption, Steam stripping,
Distillation: Vapor-Liquid Equilibrium, Method of Distillation.

4- Reactor Design I   Th. 3   App. --   Tut. 1   Units 3
Chemical reactions, Reactor types, Mass balance and conversion, Rate laws, Design Equations, Stoichiometric tables, Variable volumes, Isothermal reactor design, Batch reactor CSTR and PFR, Reactors in series and parallel, Reversible reactions, Equilibrium conversion.

5- Thermodynamics I   Th. 3   App. --   Tut. 1   Units 3
Basic concepts, Reversible process.
First law of thermodynamics and its applications for flow and for steady state flow systems. Ideal gas and the relation of thermodynamic properties for various operations of ideal gas.Heat effect: Heat capacity and thermo chemistry,
Second law of thermodynamics: Concept of entropy and third law of thermodynamics. PVT relations of fluid: Corresponding state principles an various

equations of state. Residual property: It derivation and uses.
Thermodynamic properties of fluids: The ability to derive any thermodynamic property of fluid at any conditions.

6- <u>Engineering Economics</u>   **Th. 2 App. -- Tut. 1 Units 2**

Introduction, Process design development, General design considerations, Cost estimation, Interest and Investment costs, Taxes and Insurance, Depreciation, Profitability, Alternative, Investment.

7- <u>Equipment Design I</u>   **Th. 1 App. 2 Tut. --- Units 2**

Introduction to design, Flow sheets, Line symbols, Designation and Instrumentation symbols, Mechanical design of piping system, Vessels and drums (types and uses), Design procedure of liquid surge drums, Design procedure of liquid-liquid separators (Decanters), Design steps of vertical vapor-liquid-liquid separator, Design steps of horizontal vapor-liquid-liquid separator, Introduction to mixers, Mixers (types and uses), Basic impeller types, Design procedure of mixer, Design Steps for Cyclones.

Department of Chemical Engineering
Third Year
Second Semester

1- Engineering Analysis II   Th. 3   App. --   Tut. 1   Units 3
   Mathematical statement of problem, Representation of problem, Property balance
   to obtain differential equations, Application of boundary conditions to solve
   differential equation, Salt accumulation in a tank, Radial heat and mass transfer in
   cylinders, Tubular gas preheated(force convection), Three dimensional balance,
   Unsteady state operation, solution of heat and mass transfer problems using finite
   difference, Numerical methods, Numerical methods with applications, Treatment
   of experimental results, CSTR's in Series, Mixing Tank in Series.

2- Heat Transfer II   Th. 3   App. --   Tut. 1   Units 3
   Free convection heat transfer, Condensation heat transfer, Boiling heat transfer,
   Radiation heat transfer, Introduction to Non-Newtonian Fluid, Condensation.

3- Mass Transfer II   Th. 3   App. --   Tut. 1   Units 3
   Distillation: Vapor-liquid equilibrium, Methods of distillation, Flash and
   differential, Rectification continuous, Lewis Sorel method, McCabe Thiele method,
   Feed conditions, Reflux ratio, Enthalpy-concentration diagram. Steam distillation.
   Multi component distillation: Reflux ratio, number of stage using (Short -cut
   method, Plate -to -plate calculation).
   Batch distillation with constant reflux, Batch distillation with constant product
   composition.
   Liquid-liquid Extraction: Liquid-liquid equilibrium, Single stage extraction,
   Multiple stage co-current and counter current extraction, Continuous extraction
   with reflux, Fractional extraction, Types of extractors.
   Solid-Liquid Extraction (Leaching), Factors influence the rate of leaching,
   Mass transfer in leaching operations (rate of leaching), Equipments for leaching,
   Equilibrium relations and single stage leaching, Countercurrent multistage
   Leaching, variable underflow in counter-current multistage leaching, Constant
   Underflow in Counter-current multistage leaching.

4- Reactor Design II   Th. 3   App. --   Tut. 1   Units 3
   Non-isothermal reactor design, Energy balance equation, Heat of reaction, Heat
   added, Adiabatic operations/CSTR, Adiabatic operations/PFR, Unsteady-state
   batch reactor, Adiabatic equilibrium, Conversion, Multiple reactions, Parallel
   reaction, Series reaction, Complex reaction, Yield and Selectivity.

5- Thermodynamics II   Th. 3   App. --   Tut. 1   Units 3
   Conversion of heat into work in power plant, Refrigeration, Partial molar property,
   Fugacity and fugacity coefficient, Activity coefficient equations, Vapor-liquid
   equilibrium at various conditions, Chemical reaction equilibrium.

6- <u>Chemical Industries</u>   **Th. 2   App. 2   Tut. --   Units 3**

Catalytic Industry, Sulfuric acid production, Nitric acid production, Oxygen and Nitrogen Production, Phosphoric acid production, Ammonia production, Surface Coating Industry, Oil and Fats, Detergents.

7- <u>Equipment Design II</u>   **Th. 1   App. 3   Tut. ---   Units 2**

Introduction, Heat transfer equipments, Mass transfer equipments, Vessels, Tanks, Pipes, Pumps, Design of condenser, Reboilers and Tubular Furnaces.

8- <u>English Language III</u>   **Th. 2   App. --- Tut. ---- Units 2**

Department of Chemical Engineering
Fourth Year
First Semester

1- Transport Phenomena   **Th. 3 App. -- Tut. 1 Units 3**

Transport phenomena and unit operations, Equilibrium and rate process, Molecular Transport mechanism, The analogy, Heat, mass and momentum transfer, Heat, mass and momentum diffusivities, General property balance, One dimensional balance equation, Molecular transport and general P.B. , Steady state transport with Generation, Transport with convective flux, Convection coordinate, Mass diffusion Phenomena, Boundary Layer Principles.

2- Process Control I   **Th. 2 App. -- Tut. 1 Units 2**

Design of a surge tank to smooth out fluctuation, Definition of process control terms, Math review, Lap lace transforms, Dynamic system, Dynamic behavior of first order system, Linearization and deviation variables, Transfer functions, Block diagrams, Arrangements of first order system, Second order systems.

3- Numerical Methods   **Th. 1 App. 2-- Tut. 1 Units 2**

Roots of the Equation $f(x) = 0.0$: Graphical Method, Bisection Method, False Position Method, Secant Method, Newton- Raphson Method. Solution of Differential Equation: Euler's Method, Modified Euler's Method, Rung-Kutta Method, Taylor Series Method. Solution of Linear System $Ax = B$: Introduction to Vectors and Matrices, Gaussian Elimination Method, Gauss – Seidel Methods, Matrix Inversion. Curve Fitting: Least – Square Line, Curve Fitting. Interpolation and Polynomial Approximation: Lagrange Approximation, Newton Polynomial.

4- Electrochemical Engineering   **Th. 2 App. -- Tut. 1 Units 2**

Introduction to Electrochemistry, Pourbaix Diagram, Nature of Electrode Reactions, Thermodynamics and Kinetics, Cell Potential of an Electrochemical Cell, Polarization, Activation and Concentration, Polarization, Electrical Double Layer, Over Voltage, Butler-Volume Equation, Ionic Transfer in Electrochemical Reactor, Design Equation of ECR in Laminar Flow, Design Equation of ECR in Turbulent Flow, Design Equation for PFR.

5- Petroleum Refinery   **Th. 2 App. -- Tut. 1 Units 2**

Classification and chemical composition of crude oil, Chemical and physical properties of crude oil, Crude oil evaluation, Crude oil preparation for refining, Crude oil distillation units (Topping units), Thermal processes in petroleum refinery, Catalytic processes in petroleum refinery, Lubricating oil, Chemical treatment, Production of petroleum fractions and other final products.

6- <u>Biochemical Engineering</u>　　　　　　　**Th. 2　App. --　Tut. 1　Units 2**

Introduction to biochemical engineering, Gas-liquid mass transfer in cellular systems and basic mass transfer concept, Oxygen absorption rate, Overall mass transfer correlations, Estimation of dispersed phase interfacial area and gas hold-up, Power Require for spared and agitated vessels, Power consumption and mass transfer in Non-Newtonian Fermentation, Scale-up, Heat transfer in biological process and its correlations, Sterilization, Biological reaction kinetics (biological rate equations, substrate removal rate and solution of model), Down stream processing.

7- <u>Project</u>　　　　　　　　　　**Th. --　App. 4　Tut. --　Units 2**

Introduction: Reviewing the different methods of manufacturing the product, Comparing them and choosing the suitable one, Description of chemical and physical processes and listing the main equipments in the flow sheet, Justify the production capacity of the plant.
Heat and material balance for all streams.

8- <u>Elective Subject I</u>　　　　　　　**Th. 2　App. --　Tut. 1　Units 2**

9- <u>English Language IV</u>　　　　　　　**Th. 2　　App. ---　Tut. ----　Units 2**

10- <u>Ethics</u>　　　　　　**Th. 1　　App. ---　Tut. ----　Units 1**

1- <u>المقدمة</u> : مقدمة عن اخلاقيات المهنة بشكل عام واخلاقيات المهنة الهندسية بشكل خاص

2- <u>مفهوم اخلاقيات المهنة</u> :المفهوم العام لاخلاقيات المهنة ,المفهوم اللغوي لاخلاقيات المهنة, المفهوم الاصطلاحي لاخلاقيات المهنة, اهمية اخلاقبات المهنة في الحياة, اهمية العمل في حياة الانسان

3- <u>المقومات العامة لاخلاقيات المهنة</u> :الضمير المصلحة, اللوائح والانظمة, تنظيم العمل , عقد العمل,مراقبة العمل.

4- <u>الاخلاق التي لها صلة مباشرة باخلاقيات المهنة</u> :الامانة في العمل, الصدق في العمل , النصح في العمل, العدل في العمل , السماحة في العمل, التواضع في العمل, الحلم في العمل, الصبر في العمل.

5- <u>أخلاقيات مهنة الهندسة</u> :مقدمة, أخلاقيات ممارسة المهنة الهندسية, تاريخ المدونات الهندسية, المدونات والمهن, تعدد مدونات قواعد السلوك.

6- <u>أمثلة من مدونات أخلاقيات مهنة الهندسة</u>

- مدومة البناء في بابل (قانون حمورابي)
- مدونة أبت لقواعد سلوك المهندسين المهنيين
- مدونة الجمعية القومية للمهندسين المهنيين

- مدونة معهد المهندسين الكهربائيين والالكترونيين.
- مدونات اخرى

7- <u>كتابة التقارير التقنية</u>

-تقرير مشروع التخرج: مكونات التقرير, الهدف ومتطلبات كل فصل, كيفية كتابة المصادر العلمية

- التقارير البحثية وتقارير مشروع العمل : مكونات التقرير والهدف من كل مكون.

- الامانة العلمية في كتابة التقرير والاستلال الالكتروني

- الحلقات النقاشية: اعداد وتنظيم برنامج عرض الحلقة النقاشية, متطلبات عرض الحلقة النقاشية.

Fourth Year
Second Semester

1- Unit Operations   Th. 3   App. 3   Tut. 1   Units 4

Evaporation: Heat transfer in evaporators, Heat transfer coefficient, Boiling at submerged surface, Forced convection boiling, Vacuum operation, Multiple-effect evaporators, General principles, The Calculation of multiple - effect systems, Comparison of forward and backward feeds.

Drying: Introduction and general principles, Rate of drying, Drying periods, Method using predicted transfer coefficient for constant- rate period, The mechanism of moisture movement during drying, Classification and selection of dryings

Humidification and Dehumidification and cooling towers: Humidification terms, Humidity data for air-water system, Temperature - Humidity chart, Addition of liquid or vapor to a gas, Dehumidification, Water cooling, Heat and mass transfer coefficients.

Crystallization: Introduction: Crystallization and type of crystals, Equilibrium solubility in crystallization, Yields and heat and material balances in crystallization, Equipments for crystallization. Crystallization theory: Introduction and Nucleation theories, Rate of crystal growth and ΔL law, Particle size distribution of crystals, Models for crystallization.

Mechanical and Physical Separation Processes: Settling, Sedimentation, Filtration, Centrifugal Separation.

2- Process Control II   Th. 2   App. 2   Tut. 1   Units 3

Feed back control, Servo problem and regulator problem, Examples of feed back control in process engineering, Reducing the complex block diagram, The PID (Proportional Integral Derivation) control algorithm, Stability, Routh array and root locus, Performance specifications, Frequency of dynamic system, Bode plots, Sensors used in control loops, Control valves, Controllers, Tuning of control.

3- Optimization   Th. 2   App. --   Tut. 1   Units 2

Essential features of optimization problems.

Unconstrained optimization: Single variable optimization, Indirect methods, Region elimination methods (Bisecting, Fibonacci, Golden section), Interpolation methods (Quadratic, Cubic).

Multivariable optimization: Steepest descent method, Conjugate gradient method,

Newton's method, Quasi-Newton method
Constrained optimization.

4- Corrosion Engineering   Th. 2   App. --   Tut. 1   Units 2

Corrosion types and economics, Corrosion in aqueous solutions, Electrochemical cell and corrosion cell, Over potential, Over Potential and corrosion rate, Graphical method to express corrosion rate, Cathodic reactions in corrosion, Galvanic attack, Effect of velocity, temperature and concentration, Corrosion as a mass transfer operation, Corrosion under heat transfer conditions, Passivity, Cathodic and anodic protection.

5- Petrochemical Engineering   Th. 2   App. --   Tut. 1   Units 2

Introduction: Definition of petrochemicals, Source of petrochemicals, Classification of petrochemicals.

Hydrocarbon cracking an olefins manufacture: Definition of hydrocarbon cracking process, Suggested operating conditions of the cracking reactor according to the thermodynamics and kinetics analysis, Kinetics models and cracking reactor design, Case study for cracking reactor design.

Steam reforming of hydrocarbons: Definition of hydrocarbon steam reforming process, thermodynamics of reforming process (reforming of methane), Reforming of higher hydrocarbons- thermodynamics analysis, Kinetics of steam reforming process.

Polymerization process (manufacture of liquid gasoline from gas: Definition of thermal polymerization, kinetics analysis of polymerization process, process description.

Dehydrogenation of hydrocarbons (manufacture of olefins): Definition, Thermodynamics and kinetics analysis of Dehydrogenation process, operating conditions.

Alkylation: Definition of Alkylation process, Thermodynamics and kinetics treatment.

Isomerization: Purpose of the process, Thermodynamics and kinetics analysis of isomerization process.

Acetylene manufacture from hydrocarbons: Definition, Thermodynamics and kinetics analysis of acetylene formation, optimization of acetylene formation process.

Chlorination process of hydrocarbons: Definition, kinetic treatments for parallel-consecutive reactions in PFTR and CSTR.

6- Project   Th. ---   App. 4   Tut. ---   Units 2

Design of main equipment in the fields of: Heat transfer, Mass transfer, Reactor design and Mechanical equipments.

Plant layout. Other requirements include: Cost estimation, Geographic location of the plant, Choice of suitable control devices, Effect of plant and products on the environment.

7- Elective Subject II   Th. 2   App. --   Tut. 1   Units 2

Fourth Year

Elective Subjects

1- Paper Industry

Cellulose Nonmaterial, Proximate Chemical Analysis
Pulping Processes: Chemical Methods, Semi chemical Methods, Mechanical
Methods. Types of Digesters, Technological Flow sheet of Pulping Process,
Papermaking Process, Paper Machine.

2- Polymers Reaction Engineering

Definition of polymer, Properties of polymer, Types of polymers, Chemical
structure, Types of polymers, Preparation of polymers, Estimation of molecular
weight through viscometer, Polymer processing, Extruders, Polymer composite,
Type and production of polymer composite, Calculation of the strength properties.
Copolymers, Branched and cross linked polymers, Synthesis and reactions of
polymers, polymer processing.

3- Computer Aided Design in Chemical Engineering.

Getting Started with ChemCAD: What is ChemCAD? Special Features about
ChemCAD, Accessing ChemCAD at UT.
Getting Started Right Away Two Simple Simulations: Combustion of 3-Methyl-1-
Pentene, Create a job name and file, Establish the engineering units system, Add
unit operations to the flow sheet, Connect the unit operations with streams, Build
the chemical component list, Select K-value and enthalpy thermodynamic models,
Specify feeds (and cut streams) properties, Specify equipment parameters, Run the
simulator, View the output, Save the simulation, The Simulated Haber Process,
Establishing the Engineering Units System, Adding Unit Operations to the Flow
sheet, Connecting the unit operations with streams, Building the Chemical
Component List, Selecting K-value and Enthalpy Models, Specified Feeds (and
Cut Streams), Specifying Equipment Parameters, Running the Simulator, Viewing
the Output.
Using Other Real or Quasi-Real Unit-Operations: Component Separator,
Compressor and Expander, Divider, Fired Heater, Heat Exchanger, Mixer, Liquid
Pump (PUMP), Shortcut Distillation, Stoichiometric Reactor, Valve, Flash. Using
the Controller: Introduction, How to use the controller, Controlling Streams, Unit
Operation Regulation. File Management: ChemCAD File Management Commands,
Load a Job, Copy a Job, Delete a Job, Rename a Job, Import a Job, Export a Job,
Create a Backup Job (another job case), Load a Case, Copy a Case, Delete a Case,
Rename a Case, View or Edit Case Notes, Switch Directories, View or Edit Job
Record, Windows Equivalent Commands, New, Open, Close, Save, Save As, Exit.

4-Renewable Energy.

Solar Energy, Wind Energy, Hydrothermal Energy, Tidal Energy, Geothermal
Energy, Biomass, Biomass characterization , Fermentation, Torrefication, pyrolysis,
gasification, Parameters effect on gasification, Types of gasifier, combustion, Marine
Energy Technologies.