University of Technology

Chemical Engineering Department

B.Sc. PROGRAMME
IN
CHEMICAL ENGINEERING

OUTLINE OF

SYLLABUSES ALLOCATION OF SUBJECTS

&

WEEKLY LOAD

1991 - 1992

INTRODUCTION

Chemical Engineering is distinguished from other branches of Engineering by its strong dependence on chemistry. This enables the chemical engineer to understand properties involving changes in physical state, chemical composition, or energy content for systems ranging in scale from molecules to full sized manufacturing plants.

The chemical engineer may be employed in an established industry producing chemicals, petroleum products, petrochemicals, pharmaceuticals, synthetic Fibers, Foods, plastics or metals. These products are steadily needed in an increasing amounts due to the expanding growth of population. His function may be involved in making innovations in existing operations, doing research, development and analysis of existing plants, technical services, or scale up.

Due to his board knowledge, the chemical engineer often occupies a dominant position in the above mentioned industries.

He may also apply his knowledge in such diverse areas as air and water pollution or biomedical research.

The formal course work for B.Sc. Programme involves mathematics, including both analysis and computer applications, chemistry, mechanics, electrisity and chemical engineering principles and practice subjects including fluid dynamics, heat transfer, unit operations, chemical reactor

design, thermodynamics, and chemical processes. In addition, the programme involves subjects in hummanities and social sciences to help the student to a fuller appreciation of his relationship and responsibility to society in general.

A considerable emphasis is laid, in this department, on practical training and laboratory work, which helps students in getting better understanding of the theoretical part of their curriculum.

Moreover students are required to spent twelve weeks, training in industry during summer vacations.

This booklet contains the academic programme and the syllabus for both technical and social subjects which are taken by the chemical engineering students during their four years study.

Prof. M. S. Hameed

Chairman of Chemical

Eng. Dept.

Content

3- Third Year Syllabus

4- Fourth Year Syllabus

First Year B.Sc Syllabus

	Subject	Hours/Week			
		Theoretical	Practical	Tutorial	Units
1-1	National Education and Socialism	1	-	1	2
1-2	Mathematics (1)	3	-	1	6
1-3	Material & Energy balance	3	-	1	6
1-4	Analytical Chemistry	1	2*	1	3
1-5	Organic Chemistry	2	2**	-	5
1-6	Engineering Drawing	1	2	-	4
1-7	Mechanics and Strength of Materials	2	-	1	4
1-8	Computer Science	1	1	—	3
1-9	Work Shop	-	6	-	non credit
	Sum	14	11	5	33

Note:

* 1st term

** 2nd term

Total hours: 30 hours

Second Year B.Sc Syllabus

	Subject	Hours/Week			
		Theoretical	Practical	Tutorial	Units
2-1	National Eduction and Socialism	1	-	1	2
2-2	Mathematics (2)	2	-	1	4
2-3	Fluid Mechanics	2	2	1	6
2-4	Properties of Materials	2	2**	-	5
2-5	Computer programming	1	2	1	4
2-6	Thermodynamics	2	-	1	4
2-7	Fuel Technology	1	2*	1	3
2-8	Physical Chemistry	2	2	1	6
2-9	Electrical Technology	2	-	-	4
	Sum	15	8	7	38

Note:

* 1st term

** 2nd term

Six weeks industrial training

Third Year B.Sc Syllabus

	Subject	Hours/Week			
		Theoretical	Practical	Tutorial	Units
3-1	National Education and Socialism	1	-	1	2
3-2	Applied Mathematics	2	-	1	4
3-3	Unit Operations (1)	3	3*	1	7
3-4	Project (1)	1	2	-	4
3-5	Reactor design	3	-	1	6
3-6	Mangement and Engineering Economics	2	-	1	4
3-7	Heat Transfer	2	3**	1	5
3-8	Chemical Industry	2	2	-	6
	Sum	16	7	6	38

Note:

* 1st term

** 2nd term

Six weeks industrial training

Fourth Year B.Sc Syllabus

	Subject	Hours/Week			
		Theoretical	Practical	Tutorial	Units
4-1	National Education and Socialism	1	-	1	2
4-2	Project (2)	1	2	-	4
4-3	Unit Operations (2)	3	3*	1	7
4-4	Process Control and Measurments	2	3**	1	5
4-5	Biochemical Engineering	2	-	-	4
4-6	Petrochemical Processes	2	-	-	4
4-7	Gas & Petroleum Refinery	2	3**	1	5
4-8	Statistics & Optimization	1	1	1	3
	Sum	14	7.5	5	34

Note:

* 1st term

** 2nd term

Total hours: 26.5 hours

Total hours for the four years= 116.5 hours

Total units for the four year = 145 units

First Year B.Sc Syllabus

1-1 National Education and Socialism

Theoretical	Practical	Tutorial	Units
1	-	1	2

Refer to centralize curriculum

First Year B.Sc Syllabus

1-2 Mathematics (1)

Theoretical	Practical	Tutorial	Units
3	-	1	6

1- Revision

Slope and equation of the straight line, Trigonometric functions and their sketches, Functions, Definitions; Domain, Range, Inverse of functions, Absolute value, Limits, Definitions of the limit of a function Theories about limits, Lim$_{x\to 0}$ sin x/x, Continuity, Differentiation and integration of algebraic functions.

(12 hrs)

2- Determinants

Definitions and properties, Solution of systems of equations (Cramers Rule).

(9 hrs)

3- Solution of the Algebraic Equations

Second and third order.

(3 hrs)

First Year B.Sc Syllabus

4- Transcendental Functions

Trigonometric, INV., Natural logarithmic, Exponertial and power functions, Sketches.

(12 hrs)

5- Conic Sections

Circle, Prabolic, Ellipse.

(6 hrs)

6- Hyperbolic Functions

Definitions, Derivatives and integrals.

(6 hrs)

7- Application of Integrals

Area between two curves, Volumes, Length of curves, surface area.

(12 hrs)

8- Methods of Integration

Basic formula, Power of trigonometric functions, Integrals involve $\sqrt{a^2 - x^2}$, $\sqrt{a^2 + x^2}$, $\sqrt{x^2 - a^2}$, Integrals of $ax^2 + bx + c$, Partial functions, Integration by parts, The substitution U = tan (x/2), Improper integrals (conv. and dity).

(15 hrs)

9- Complex Numbers

Definitions, Argands diagram, Product and quotient of two numbers, z = r (cos r + i sin r) and roots of equation, conjugate numbers, Demoivros theorem.

(6 hrs)

10- Vector Analysis

Vector components and the unit vector i and j, Addition and subtraction of vectors, Length of vector, multiplication by scalars, Zero vector, Direction, Unit vector.

(4 hrs)

11- Polar Coordinates

The polar coordinates system, Graphing of polar coordinates, Derivatives and tangent lines and area in polar.

(5 hrs)

First Year B.Sc Syllabus

1-3 Material and Energy Balance

Theoretical	Practical	Tutorial	Units
3	-	1	5

1- Concept of Chemical Engineering

Units, Dimensions, Conversion factors, Temperature, Pressure, Composition, Chemical analysis, Chemical equations.

(24 hrs)

2- Material Balance Calculation

Without and with chemical reaction, Recyle, By pass and purge calculations for study state, Combustion calculation.

(30 hrs)

3- Definitions of Ideal Gas Laws

Real gas, Vapour pressure calculation.

(9 hrs)

4- Energy Balance

General energy balance, Enthalpy, Heat capacities their predictions and variation with temperature, Heat effects.

(15 hrs)

5- Simultaneous, Mass and Energy Balance.

(12 hrs)

First Year B.Sc Syllabus

1-4 Analytical Chemistry

Theoretical	Practical	Tutorial	Units
1	2*	1	3

1- Introduction

Atomic weight, Molecular formula, Chemical equations, Mole concept, Chemical equilibrium.

(2 hrs)

2- Solution

Definition, Preparation and properties, Concentration; Physical Methods, Percentages, PPM, Chemical methods; Molarity, Molality, Normality, Formality, PH, POH, Solubility, Dilute solutions, Saturated and super-saturated solutions.

(8 hrs)

3- Analytical Methods of Analysis

a- Qualitative Analysis

(2 hrs)

b- Quantitative Analysis

i- Volumetric (titrimetric) analysis, Acid - base, Redox, precipition, Complex titration, Methods of calculations, Titration curves.

6 hrs)

ii- Gravimetric Analysis

Precipitation reactions; Direct and indirect methods of analysis, ksp.

6 hrs)

iii- Instrumental Methods of Analysis;

a- Electromagnetic spectrum

b- Photochemistry; Photometric methods, Colourimetry, atomic absorption.

c- PH - meter

(6 hrs)

Note:

* 1st term

First Year B.Sc Syllabus

1-5 Organic Chemistry

Theoretical	Practical	Tutorial	Units
2	2**	-	5

1- Introduction

Definition, Carbon atom, Classification of organic compounds.

3 hrs)

2- Aliphatic Compounds

Nomenclature, Preparation, Properties, Reactions.

a- Alkanes b- Alkenes c- Alkynes

d- Aliphatic Derivatives: Alkyl halides, Alcohols, Ethers, Aldehyde, Ketones, Esters, Carboxylic acid, Amines, Mercaptans, Thiophenes, Disulphide.

26 hrs)

3- Aromatic Compounds

Structural formula of benzene ring, Nomenclature, Preparations, Properties, Chemical reactions; Nitration, Sulphonation, Halogenation, Alkylation, Benzene - homologues; Preparation properties, Chemical reactions of:- toluene, xylene, ethyl benzene, styrene, phenols, anilines, naphthalene.

(20 hrs)

First Year B.Sc Syllabus

4- Hetrocylic Compounds

Pyridine, Furan, Pyrrole

(3 hrs)

5- Introduction to Polymer and Carbohydrates

(4 hrs)

6- Organo - Metallic Compounds

(4 hrs)

Note:

** 2nd term

First Year B.Sc Syllabus

1-6 Engineering Drawing

Theoretical	Practical	Tutorial	Units
1	2	-	4

1- Introduction

Drawing instruments and their uses, Types of lines used in drawings.

(2 weeks)

2- Geometrical Constructions

(2 weeks)

3- Pictorial Drawings (Isometric and Oblique)

(2 weeks)

4- First and Third Angle Projection. Multiview drawings.

(4 weeks)

5- The Findings of 3rd View

(1 weeks)

6- Sectioning

(2 weeks)

7- Fastners

(1 weeks)

8- Assembly and Detail Drawing

(1 weeks)

First Year B.Sc Syllabus

1-7 Mechanics and Strength of Materials

Theoretical	Practical	Tutorial	Units
2	-	1	4

A- Mechanics

1- Principles of Statics (3 hrs)

2- Resultants of Force Systems (3 hrs)

3- Equilibrium of Force Systems (3 hrs)

4- Friction (3 hrs)

5- Centroids and Centers of Gravity (6 hrs)

6- Moment of Intertia (3 hrs)

7- Frame Works Analysis (5 hrs)

8- Forces in Space (4 hrs)

First Year B.Sc Syllabus

B- Strength of Materials

1- Internal Forces in Non - Rigid Bodies (1 hr)

2- Definition of Stress and Strain

Types of stresses and strains, Shear stress.

(2 hrs)

3- Hooks law

(2 hrs)

4- Free - Body Diagrams

(1 hr)

5- Stress - Strain Diagrams

Stress, Strain diagrams for ductile and brittle materials.

(2 hrs)

6- Proportional Limits

Elastic limit, Stiffness elasticity, Plasticity, Toughness resilience, Hardness, Poisson's ratio, Bulk modulus.

(6 hrs)

7- Composite Stress

(4 hrs)

8- Thermal Stress

(3 hrs)

9- Torsion and Power Transmision by Shaft

(5 hrs)

10- Beam, Shear and Moments in Beams Deflection

(4 hrs)

First Year B.Sc Syllabus

1-8 Computer Science

Theoretical	Practical	Tutorial	Units
1	1	-	3

1- Introduction

The need of data processing, Historical background, Application of computers, Electronic computer generations, Kind of computers, Micros, minis, and main - frame.

(3 hrs)

2- Computer Hardward

Peripherals, Binary system

(3 hrs)

3- Programming Languages

Low level, High level

(3 hrs)

4- Programming In Basic

Algorithms and flowcharts, Input / output, Control statments, Arrays

(21 hrs)

First Year B.Sc Syllabus

1-9 Work Shop

Theoretical	Practical	Tutorial	Units
-	6	-	non-credit

1- Automotive Mechanics

2- Electricity

3- Foundary

4- Carpentury

5- Fitting

6- Sheet Metal

7- Machining

8- Welding

9- Forging

Second Year B.Sc Syllabus

2-1 National Education and Socialism

Theoretical	Practical	Tutorial	Units
1	-	1	2

Refer to centralize curriculum

Second Year B.Sc Syllabus

2-2 Mathematics

Theoretical	Practical	Tutorial	Units
2	-	1	4

1- Partial Differentiation

Functions of two or more variables, Limits and continuity, Partial derivatives, Chain rule, Gradients, Directional derivatives, and tangent plane, Higher order derivatives, Maxima, minima and saddle points, Langrange multipliers

(10 hrs)

2- Complex Algebra

Revision, The complex variables, Derivation of complex variables, Analytic function, Integration of functions of complex variables and cauchy's theorem.

(6 hrs)

3- Multiple Integrals

Double integrals, Area, Triple integrals in rectangular coordinates, Physical application in the three dimensions.

(3 hrs)

4- Ordinary Differential Equations

Solution of first order ordinary differential equations, Solution of second order ordinary differential equations,

Solution of higher order ordinary differential equations.

(3 hrs)

5- Vector Analysis

Revision, Quadratic surfaces, Green's theorem, Stock's theorm.

(4 hrs)

6- Function and Definit Integrals

The error function, The gamma function, The beta function, Evaluation of definit integrals.

(6 hrs)

7- Infinite Series

Power series of functions, Taylor's theorm, Convergence of power series, Integration, Differentiation, Multiplication and division, Fouries series, Even and odd functions, Half range expansion, Periodic functions

(10 hrs)

8- Matrices

The Matrix, Matrix algebra, The transpose of matrix, The inverse of matrix, Eigen values and Eigen vectors.

(8 hrs)

Second Year B.Sc Syllabus

2-3 Fluid - Mechanics

Theoretical	Practical	Tutorial	Units
2	2	1	6

1- Introduction

Physical Properties of fluid, Definition of type fluid (Fluid, Newtonian, Non - Newtonian, Incompressible, Compressible fluid and static, dynamic fluid).

(2 hrs)

2- Dimensional - Analysis

Rayleigh's method (normal method), Buckingham's OPO - theorem.

(6 hrs)

3- Fluid Static

Pressure measuring devices (manometers, mechanical gauges, tanks head).

(4 hrs)

4- Incompressible Fluid, (Newtonian fluid)

Continuity equation, Derivation of Bernulli's equation, correction to Bernulli's equation, Effect of friction, Calculation of friction in straight pipe and fitting, Calculation of pressure drop in straight pipe.

(10 hrs)

Second Year B.Sc Syllabus

5- Flow Measurement

Pitot tube, orifice meter, venturi meter, Rotameters, Notch or weirs.

(12 hrs)

6- Pumping of Liquid

Calculation of Total head, NPSH, Performance characteristics curve, Calculation of horsepower, Equipment.

(6 hrs)

7- Non - Newtonian Fluid

Definition, Type of fluid depend on time, Calculation of friction & pressure drop for general time independent in laminar & Turbulent flow.

(2 hrs)

8- Compressible Fluid

Pressure wave, General equation, General eq. for isothermal & adiabatic condition, Work for isothermal & adiabatic, equipment.

(12 hrs)

9- Flow of Fluid Through Granular Beds & Packed Column

Fixed bed, Fluidised bed

(6 hrs)

Second Year B.Sc Syllabus

2-4 Properties of Materials

Theoretical	Practical	Tutorial	Units
2	2**	-	5

1- Atomic Structure (4 hrs)

2- Crystaline Structure (5 hrs)

3- Miller Indices, X-Ray diffraction (3 hrs)

4- Imperfection in Crystals (4 hrs)

5- Atoms Movements in Engineering Materials (4 hrs)

6- Thermal Properties of Engineering Materials (2 hrs)

7- Electrical Properties of Engineering Materials (3 hrs)

8- Solid Solution (2 hrs)

9- Phase Diagrams (1 hrs)

Second Year B.Sc Syllabus

10- Ferrous Metals and Non - Ferrous Metals and their Alloys

(6 hrs)

11- Corrosion

Types of Corrosion and Corrosion Preventation

(6 hrs)

12- Polymers

Definition, Classification, Molecular weight distribution, Effect of molecular weight on the properties of polymers, Types of polymers and rubbers and their uses.

(6 hrs)

13- Ceramics

Action of heat on clays SiO_2 - Al_2O_3 - Phase diagram, Differential thermal analysis (DTA), Refractories and glasses.

(5 hrs)

14- Composite materials

Methods of preparation of composite materials, (cermets), Mechanism of adhasion between metallic molten and ceramics materials. Fibers and types, Reinforced plastic, Dispersion of powder without and with phase change.

(5 hrs)

Note:

** 2^{nd} term

Second Year B.Sc Syllabus

2-5 Computer Programming

Theoretical	Practical	Tutorial	Units
1	2	1	4

1- Control Statments

GO TO, IF Then, Looping, For, Next, Multiple Loops, ON GO TO, Application in series evaluation, Statistics, and Newton - Raphson Iteration.

(6 hrs)

2- Subscripted Variables

Arrays and subscripts, DIM, One - dimensional arrays, Two - dimensional arrays, Applications in numerical methods.

(6 hrs)

3- Subprograms

Types of subprograms, Functions, DEF FN, Subroutines, GOSUB RETURN, Applications.

(6 hrs)

4- Peripheral Operations

Printers, LLIST, L PRINT, Casette recorders Floppy drives, Files, SAVE, LOAD, MERGE, File 1/0 operations.

(6 hrs)

5- Graphics

CRT, Types of screens, Pixels, Screen, Pset, Line, Circle, Draw, Applications in curve plotting.

(hrs)

6- Other Computer Languages

FORTRAN, Structured programming, Fourth - generation languages, Application packages, Artificial intelligence.

(hrs)

Second Year B.Sc Syllabus

2-6 Thermodynamics

Theoretical	Practical	Tutorial	Units
2	-	1	4

1- Introduction

Fundamental quatities, Time, Length, Mass, Force, Temperature, Secondary quatities, Volume, Pressure, Work, Energy Heat.

(2 hrs)

2- First Law and Other Basic Concepts

Joules experiments, Internal Energy Formulation of the first law, Thermodynamics state and state functions Enthalpy, The steady state flow processes, The reversible processes, Heat Capacity and specific Heat, Equilibrium, the phase rule.

(4 hrs)

3- Applications of the Equations of Ideal Gases, Generalized Correlation and the Acentric Factor.

(8 hrs)

4- Heat Effects

Heat capacities of gases as a function of temperature, Solids and liquids, Heat change accompanying phase change, Heat of formation, Combustion and reaction, Heat of industrial reactions.

(5 hrs)

5- The Second Law of Thermodynamics

Heat engine, Enthropy, Second law limitation and real process, Entropy change and irrversibility and probability (statistical thermodynamics), Third law of thermodynamics.

(5 hrs)

6- Thermodynamics Properties of Fluids.

Relationships among the thermodynamics properties (including Helmotz and Gibbs free energies and chemical potential), Steam formation and two phase system, Saturated temperature and pressure, Triple point, Wet vapour and dryness fraction, Types of thermodynamic tables and diagrams, Steam power plant cycle and analysis, Barometric condenser, Metering and throttling processes, Steam and gas turbines.

(10 hrs)

Second Year B.Sc Syllabus

7- Refrigeration and Liquification

Refrigeration cycles (Carnot, Air, Vapor - Compression) and Comparisons, Choice of refrigerant, Absorption Refrigeration, The heat pump, Liquifaction process.

(12 hrs)

8- Phase Equilibrium

The nature and criteria of equilibrium, Binary system, Vapor pressure of an ideal solution and non ideal solutions, Henrys law, Activity and activity coefficients, Flash seperation calculations.

(6 hrs)

9- Chemical Reaction Equilibrium

Thermodynamics of ideal gases and mixtures, Derivation of the general equilibrium expression, Chemical equilibrium of ideal and non - ideal gases, Reaction equilibrium in solutions, effect of temperature on chemical equilibrium.

(6 hrs)

Second Year B.Sc Syllabus

2-7 Fuel Technology

Theoretical	Practical	Tutorial	Units
1	2*	1	3

1- Energy and Fuels
2- Classification of Fuels (3 hrs)

3- Evaluation of Crude Oil
4- Production of Petroleum Fractions (4 hrs.)

5- Motor Gasoline
6- Kerosine and Jet Fuels
7- Diesel Fuels
8- Fuel Oils
9- Lubricating Oils and Asphalte (7 hrs.)

10- Gaseous Fuels
11- LPG, LNG (3 hrs.)

12- Combustion Calculations
13- Combustion Characteristics (4 hrs.)

14- Gaseous Fuels Burners
15- Liquid Fuels Burners (6 hrs.)

16- Combustion in Furnaces and Boilers (3 hrs.)

Note:

* 1st term

Second Year B.Sc Syllabus

2-8 Physical Chemistry

Theoretical	Practical	Tutorial	Units
2	2	1	6

1- The Discription of Physical Systyems - PVT

Equation of state of an ideal gas, Equation of state and PVT relationships, PVT behaviour of real gases, The Van der Wall's equation and liquifaction of gases, The reduced state of real gases & Redlich - Kwong equation.

(10 hrs)

2- Change of State

One component systems: water, carbon dioxide and helium, Vapor pressure and external pressure, Liquid - vapor composition diagram, Liquid - liquid binary solution mixture, Rault's law for ideal mixtures, Non-ideal liquid mixtures, The principle of distillation, Henry's law, solubility of gases in liquids.

(10 hrs)

Second Year B.Sc Syllabus

3- Surface Chemistry

Pressure difference across curved surfaces, Surface tension, and capillary rise, Langmuir adsorption isotherm and langmuir theory of adsorption, Calculations of surface area of the adsorbent, BET equation for surface area calculation.

(10 hrs)

4- Chemical Kinetics

The rate of chemical reactions, order of reaction and rate constant, zero, first, second and third order rate equations, Reversible reactions, Consecutive reactions, Parallel reactions, Determination of the order, Reactions in flow systems, Effect of temperature on reaction rate, The transition - state theory, Catalysis and homogenous catalysis and heterogenous reactions, Enzyme reactions and kinetics of reactions.

(18 hrs)

5- Electrochemistry

Conductivity measurements, Diffusion and ionic mobilities, Activity and ionic strength, Determination of activity coefficient from solubilities, The Debye - Hucke. theory, Acid - base catalysis and their dissociation constant.

(6 hrs)

6- Electrochemical Cells

Electromotive force (EMF) of a cell, Measurments of EMF - the potentiometer, The polarity of electrods, The cell reactions and reversible cells, Free energy and reversible cells, Types of half cells and classification EMF, Standard electrode potentials, Standard free energy and entropy of aqueous ions, Calculation of EMF of a cell, Oxidation - reduction reactions, Concentrations cells, Electrolysis, Corrosion.

(6 hrs)

Second Year B.Sc Syllabus

2-9 Electrical Technology

Theoretical	Practical	Tutorial	Units
2	-	-	4

1- Semiconductors Equipment (6 hrs)

2- Rectifiers and Detectors (4 hrs)

3- Electronic Amplifiers (8 hrs)

4- D. C. Circuits (4 hrs)

5- D. C. Generators and Motors (6 hrs)

6- A. C. Circuits (6 hrs)

7- Polyphases Circuits (4 hrs)

8- Transformers and Induction Motors (6 hrs)

9- Starters (4 hrs)

Second Year B.Sc Syllabus

10- Integrated Circuits, Measuring Instruments, Tranducers, Transmitter

(8 hrs)

11- Electrical Heating Appliances

(4 hrs)

Third Year B.Sc Syllabus

3-1 National Education & Socialism

Theoretical	Practical	Tutorial	Units
1	-	1	2

Refer to centralize curriculum

Third Year B.Sc Syllabus

3-2 Applied Mathematics

Theoretical	Practical	Tutorial	Units
2	-	1	4

1- Revision ordinary differential equation, Simultaneous differential equations, Application for chemical engineering.

(12 hrs)

2- Solution of differential equation by series, Simple series, Method of Frobeins, Bassel's equation, Application for chemical engineering.

(8 hrs)

3- The laplace transformation, The Laplace transformer, Properties of the laplace transformation, The inverse transformation, Inversion by partial fraction, Convolution, Solution of differential equations, The transforms of special functions, Step function, Staircase function, periodic function, Trigonometric.

(10 hrs)

4- Dynamic and control for chemical processes, Dynamic and control, Dynamic behaviour for 1st order system.

(10 hrs)

Third Year B.Sc Syllabus

5- Partial Differential Equations

Formulating of partial differential equations, Derivation of heat conduction equation, Wave equation and Laplace equation, Solution of partial differential equations, Method of separating of variables and Laplace transformation method.

(8 hrs)

6- Numerical Analysis

The difference operators, Interpolation, Finite difference equations, Differentiation and integrations, Solution of first and second order differential equation.

(12 hrs)

Third Year B.Sc Syllabus

3-3 Unit operations (1)

Theoretical	Practical	Tutorial	Units
3	3*	1	7

1- Unit Operation

Introduction, Definition of Unit operation process, Definition of Mass transfer, Classification of Mass transfer operations, Method of conducting Mass transfer operations, Kind of Mass transfer operations, Type of Mass transfer operations.

(4 hrs)

2- Diffusion

Introduction, Theory of diffusion, Ficks law, Molecular diffusion, Laminar and Eddy, Diffusion in gases, Equimolecular diffusion, Maxwell's law of diffusion, Steady state diffusion of A through (stagnant) nondiffuse B, Steady state diffusion in tube with change in path length, Diffusion through a varying cross-sectional area, Diffusion from sphere, Diffusion through non - uniform cross - sectional area, Diffusion of gases A & B plus convection, Steady state diffusion in multicomponent gas

mixture, Diffusion in Liquids, Equimolar diffusion of liquid A and B, Diffusion of Liquid A through non - diffuse B, Diffusion through varying cross sectional area, Diffusion in Multicomponent liquid mixture, Diffusion in solid, Diffusion in solid following Fick's law, Diffusion in solid using permeability equation, Calculation of diffusivity coefficient, for gas, for liquid, Determine diffusivity at different temp., Diffusivity at different temp., Diffusion in multicomponent plus convection.

3- Absorption of Gases

Definition, Conditions of equilibrium between gas and liquid, Influence of solubility of gas on equilibrium curve & mass transfer coefficients, Capacity of column for dilute mixture, Methods of calculating the number of transfer unit (N. T. U), Relation between the individual and overall height of mass transfer coefficient relation, Capacity of column for concentrated mixture, Limiting flow rates, Minimum theoretical liquid flow rate.

4- Distillation

Equilibrium relationship, Temperature composition diagram, Method of predicting equilibrium data, Partial vaporization and partial condensation, Types of distillation, batch distillation, flash distillation, continuous distillation, method of calculating plate columr.

Upper operating line equation, Lower operating line equation, Lewis - sorel method, McCabe and Thiele method, The intersection of the operating lines with feed composition, Feed at boiling point, Feed not at boiling point (q - line equation), Limits of reflux ratio, Total reflux, Minimum reflux ratio, Operating & optimum reflux ratio, The location of feed plate, Normal distillation column, Stripping - distillation column, Enriching - distillation column, Rectification with direct stream injection, Rectification tower with side streams. Tray or stage efficiency, Ponchou - Savarit method "Enthalpy - concentration method", Upper & lower operating line, Reflux ratio, Min. reflux ratio, Total reflux ratio, q - line on Ponchoue - Savarit diagram, Distillation with two feed by Pochoue - Savarit method, Calculation of heat of boiler and condenser, Multicomponent distillation, Equilibrium data, Relative volatility, Tray to tray calculation.

(10 hrs)

5- Mechanical Seperation Process

1- Definition

2- Size reduction

(3 hrs)

Note:

* 1st term

Third Year B.Sc Syllabus

3-4/ Project (1)

Theoretical	Practical	Tutorial	Units
1	2	-	4

1- Report Writing and Reviewing the Different Method of Manufacturing the Product.

(2 hrs)

2- Justify Production Capacity.

(2 hrs)

3- Choosing & Justifying Geographic Location of the Plant.

(4 hrs)

4- Brief Description of Chemical and Physical Processes Involved.

(2 hrs)

5- Process Planning

Schedualing and flow sheet design, Flow sheet types and designation, Block diagram, Process flow sheet, Piping and instruments diagram, Utility flow sheet.

(14 hrs)

6- Fundemental Concepts in Mass Balance

(3 hrs)

7- Fundemental Concepts in Energy Balance

(3 hrs)

Third Year B.Sc Syllabus

3-4 Reactor Design

Theoretical	Practical	Tutorial	Units
3	-	1	6

1- Introduction

(4 hrs)

2- Type of Reactors

Batch Reactors, Continuous - Flow Reactors i.e. CSTR, PFR, Industrial Reactors.

(10 hrs)

3- Tubular Reactors

Design Equation, Reaction time, Maximum production rate, Non isothermal operation, Adiabatic operation.

(6 hrs)

4- Tubular Reactors

Design Equation, Isothermal and nonisothermal operation, Space time, Space velocity.

(8 hrs)

5- Continous Stirred Tank Reactors

Design Equation, Graphical methods (mixing).

(6 hrs)

Third Year B.Sc Syllabus

6- Mixing

(4 hrs)

7- Applications of the Design Equations fiting CSTR, PFR Reactors in series comparing Volumes of CSTR's in series

(10 hrs)

8- Reactor Design

Scale up of liquid - phase batch data to the design of a CSTR.

(6 hrs)

9- Design of CSTR's

CSTR's in parallel, Design of PFR, Length of reactor, Number of tubes, Pressure drop.

(6 hrs)

10- Comparison of Batch, PFR and CSTR for a single and Multiple Reactions.

(4 hrs)

11- Unsteady State Operation of Reactors

Start up of CSTR, Semibatch Reactor.

(4 hrs)

12- Catalysis and Catalytic Reactor.

Synthesizing a rate law, Mechanisim and rate limiting step.

(4 hrs)

Third Year B.Sc Syllabus

13- Design of Reactor for Gas - Solid Catalytic Reactions.

(6 hrs)

14- External Transport in Heterogeneous Reactions

Mass and heat transfer correlations.

(4 hrs)

15- Internal Transport Processes

Diffusion and reaction in porous catalysts.

(4 hrs)

16- Multiphase Reactor

Slurry reactor

(4 hrs)

Third Year B.Sc Syllabus

3-6 Mangement & Engineering Economics

Theoretical	Practical	Tutorial	Units
2	-	1	4

Part - One: Engineering Economics

1- Introduction to Process Economics

(2 hrs)

2- Elements of Economic Analysis

Money value, Type of interest and interest, Compounding profitability analysis, Depreciation, Continous cash flow, Discounted cash flow.

(8 hrs)

3- Visibility Studies

(Technical and economic studies)

(4 hrs)

4- Cost Estimation

Equipment cost, Fixed cost, Manufacturing cost, Plant cost.

(10 hrs)

5- Economic Design Criteria

Profitability studies present value of future money

complition for capital, Evaluation of desig: critrion accounting for risk economic life of processes.

(6 hrs)

Part - Two: Industrial Management

1- Principles and Application of Management

Basic elements of managing organization - production, marketing, Finance,public relation, Planning ... etc.

(6 hrs)

2- Wages

Payments and procedure, Motivation

(4 hrs)

3- Maintenance

Purpose and responsibility, Cost, Decision making.

(4 hrs)

4- Quality Control

Specification, Inspection of samples, Sampling, quality control chart.

(4 hrs)

5- Training

Objectives, Programs, Needs, Methods).

(4 hrs)

Third Year B.Sc Syllabus

6- Production Planning, Material handling, Production methods.

(2 hrs)

7- Industrial Safety

(2 hrs)

8- Feasibility Study of Project

(2 hrs)

Third Year B.Sc Syllabus

3-7 Heat Transfer

Theoretical	Practical	Tutorial	Units
2	3**	1	5

1- Modes of Heat Transfer

Material properties of importance in heat transfer.

(1 hrs)

2- Steady State Heat Conduction in One Dimension

Plane wall, Radial systems, Heat source systems, Boundary surrounded by fluids, Overall heat transfer coefficient, Extended surface conduction systems, Fins).

(12 hrs)

3- Principles of Convection

Transport equations, Fluid mechanism aspect of convection, Laminar boundary layer, Thermal boundary layer, Empirical and practical relations for pipe and tube flow, Flow normal to single and tube banks.

(10 hrs)

4- Heat Exchangers

Various types and their general characteristics, Fouling factor, Heat exchanger mean temperature differences, Co -

current and counter - current flow, Parallel and series arrangements, Pressure drop calculations.

(8 hrs)

5- Shell and Tube Exchangers

Types and various specifications, Design calculations by conventional method and by effectiveness and (NTU) method, Optimum design calculation.

(4 hrs)

6- Condensation and Boiling Heat Transfer

Condensation of single vapour, Design calculations for condenser, Condenser - subcooler and desuperheater - condenser.

(6 hrs)

7- Radiation and Furnace Design

Radiation properties, Shape factor, Heat excharge for non black bodies, Parallel planes, Shields, Gas radiation, Boiler.

(10 hrs)

8- Unsteady State Heat Transfer

(8 hrs)

Note:

** 2^{nd} term

3-8 Chemical Process Industries

Theoretical	Practical	Tutorial	Units
2	3	-	6

1- Chemical Operations

Introduction and general methods of calculations of, Percentage conversion, percentage recovered - recycled ratio.

(6 hrs)

2- Sulphuric Acid

(4 hrs)

3- Ammonia, Nitric Acid, Nitrogenous Fertilizers

(6 hrs)

4- Phosphates, Phosphoric Acid, Phosphate Fertilizer

(6 hrs)

5- Electro Chemical Analysis

Production of chlorine and chloride products, Caustic soda, Aluminium metal industry.

(6 hrs)

6- Industrial Chemical Salts

(4 hrs)

Third Year B.Sc Syllabus

7- Ceramic Industries

(6 hrs)

8- Cement Industry

(4 hrs)

9- Glass Industries

(4 hrs)

10- Surface Coating Industries

(4 hrs)

11- Vegetable Oils, Fats and Soaps

(5 hrs)

12- Industrial Detergents

(2 hrs)

13- Food Industries

(3 hrs)

Fourth Year B.Sc Syllabus

4-1 National Education and Socialism

Theoretical	Practical	Tutorial	Units
1	-	1	2

Refer to centralize curriculum

Fourth Year B.Sc Syllabus

4-2 Project (2)

Theoretical	Practical	Tutorial	Units
1	2	-	4

Part - One: Theory

1- Principle of industrial design

2- Type of Industrial equipments

3- Pumps and piping network

4- Vessels and tanks

5- Heat transfer equipments

6- Mass transfer equipments

Part - Two

1- Complete Detailed Design of Main Equipments

Distilliation, Absorption or stripping, Extractor, Heat exchanger, dryer, Furnace, Reactor, Separating vessel, storage tank, Piping system.

2- Choice of Suitable Control Devices for Used Equipment

3- Economical Studies

Fixed and operating cost, Equipment cost and cost of unit product.

4- Use a Computer Program to Design at Least Two Equipments

Fourth Year B.Sc Syllabus

4-3 Unit Operations (2)

Theoretical	Practical	Tutorial	Units
3	3*	1	7

1- Boundary Layer and Analogies

Velocity distribution profile, Temperature distribution profile, Analysis of heat, mass, and momentum transfer.

(14 hrs)

2- Evaporation

Heat transfer in evaporators, Heat transfer coefficient, Boiling at submerged surface, Forced convection boiling, Vacume operation, Multiple - Effect Evaporators, General principles, The calculation of multiple - effect systems, Comparison of forward and backward feeds.

(14 hrs)

3- Drying

Introduction and general principles, Rate of drying, Drying periods, The mechanism of moisture movement during drying, Classification and selection of dryers.

(8 hrs)

4- Crystallisation

Introduction, Growth and properties of crystals, Nucleation, Crystallisation rate, Effect of impurities on crystal formation, Effect of temperature on solubility, Crystallisers, Batch crystallisers, Continuous crystallisers.

(3 hrs)

5- Humidification and Dehumidification and Cooling Tower

Humidification terms, Humidity data for air - water systems, Temperature - Humidity chart, Addition of liquid or vapour to a gas, Dehumidification, Water cooling, Height of packing, Change in air condition, Evaluation of heat and mass transfer coefficients, Systems other than Air - water.

(14 hrs)

6- Extraction

The mixing of liquid - liquid systems, liquid - liquid extraction, Application, Design consideration, Equilibrium conditions, Calculation of the number of theoretical stages in extraction operatiop, Co - current contact with partially miscible solvents, Co - current contact with immiscible solvents, Counter - current contact with

partially miscible solvents, Counter - current with immiscible solvents, Continuous Extraction in columns.

(14 hrs)

7- Mechanical and Physical Separation Processes

Setting and sedimentation, Filteration and centrifugal separation.

(18 hrs)

Note:

* 1st term

Fourth Year B.Sc Syllabus

4-4 Process Control

Theoretical	Practical	Tutorial	Units
2	3**	1	5

1- Process Dynamics and Transient Response of the Systems

Review of dynamic behaviour of first - order systems, Linearization techniques of non linear systems, Transient response of interacting and non - interacting systems, Second-order systems and their dynamic characteristics, Transient response of transportation lag system

10 hrs)

2- Characteristics of the Closed Logs Systems

Overall closed logs transfer functions and block diagram algebra, Transient response of simple closed control systems, Stability of control systems, Introduction to the frequency analysis and design techniques.

(20 hrs)

Fourth Year B.Sc Syllabus

3- Measurements

Absolute and relative measurments, independent and dependent variables, erors, types of errors, error estimation, propogation of errors, Measuring Instruments Temperature, pressure, flow rate, level.

(10 hrs)

4- Industrial Controller Actions

Selection criteria for various control modes, Final control elements, Dynamic and control of chemical reactor system.

(10 hrs)

5- Dynamic and Control of Some Chemical Processes

Dynamic and control of heat exchangers, Dynamic and control of Distillations columns, Introduction to computer control of chemical processes.

(10 hrs)

Note:

** 2nd term

Fourth Year B.Sc Syllabus

4-5 Biochemical Engineering

Theoretical	Practical	Tutorial	Units
2	-	-	4

1- Introduction

(4 hrs)

2- Kinetics of Substrate Utilization

(20 hrs)

3- Kinetics of Enzyme. Catalysed Reactions and Enzyme Mechanisms

(8 hrs)

4- Transport Phonomena in Biochemical Systems

(9 hrs)

5- Design and Analysis of Biochemical Systems

(12 hrs)

6- Application of Biochemical Engineering

(8 hrs)

Fourth Year B.Sc Syllabus

4-6 Petrochemical Process Industries

Theoretical	Practical	Tutorial	Units
2	-	-	4

1- Nature of Petrochemical Processes

5 hrs)

2- Basic Petrochemical Materials

Low olefins - production process of ethylene, Pyrolysis processes, Cooling processes, Gas compression, Product refinery, Separation operations, Energy system, Diolefins, Highers olefins, Aromatics, Synthesis gas.

20 hrs)

3- Intermediate Petrochemicals

Based on basic petrochemicals - Item (2) above

15 hrs)

4- Final Products

Polymers, Plastics, Elastomens, Fibers.

13 hrs)

5- Petrochemical Complexes

7 hrs)

4-7 Gas and Petroleum Refinery

Theoretical	Practical	Tutorial	Units
2	3**	1	5

1- Physical and thermodynamical properties of hydrocarbon fluids

(2 hrs)

2- Vapour - Liquid behaviour of HC fluids, Flash Degasing) calculation

(4 hrs)

3- Separation by Absorption and Fractionation

(4 hrs)

4- Crude Oil Properties Evaluation of Crude Oils

(2 hrs)

5- Refinary Products

(2 hrs)

6- Crude Oil Distillation

(6 hrs)

7- Cracking Processes

(4 hrs)

8- Desulfurization

(2 hrs)

Fourth Year Syllabus

9- Catalytic Reforming and Isomerization

(4 hrs)

10- Lubricating Oils

(2 hrs)

11- Producer Gas

(3 hrs)

12- Water - Hydrocarbon System Behaviour

(2 hrs)

13- Adsorption Dehydration and Sweetening

(4 hrs)

14- Absorption Dehydration and Sweetening

(3 hrs)

15- Sulfur Recovery

(2 hrs)

16- Liquefaction Processes

(4 hrs)

17- Economic Evaluation
18- Cost Estimation

(6 hrs)

19- Typical Design Calculations

(4 hrs)

Note:

** 2nd term

Fourth Year B.Sc Syllabus

4-8 Statistics and Optimization

Theoretical	Practical	Tutorial	Units
1	1	1	3

Part One: Statistics

1- Introduction

Statistics, Descriptive and inductive statistics, Discrete continuous variables, Population, Sample, Graphical representation of data.

(2 hrs)

2- Frequency Distributions

Frequency distribution table, Relative frequency distribution table, cumulative distribution, graphical representation of frequency distributions.

(2 hrs)

3- Measures of Central Tendency

Arithmetic mean, Geometric mean, Root mean square, Median, Mode.

(2 hrs)

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4- Measures of Dispersion

Mean Absolute Deviation, Range, Standard deviation variance.

(2 hrs)

5- Probability Distributions

Discrete probability distribution - binomial distribution poisson distribution, Continuous probability distribution, normal distribution, Area under normal curve, Chi - square distribution.

(2 hrs)

6- Curve fitting

Curve fitting, Method of least squares, Least square line, Non linear relations, Polynomials, Time series, correlation, Regression, Coefficient of correlation.

(3 hrs)

Part Two: Optimization

1- Introduction to Process Optimization

(1 hrs)

2- Organization of Optimization Problem System Models

(1 hrs)

3- Single Variable

Analytical method, Numerical method, Graphical method, Numerical search, Bounded function, Open ended function, Direct search, Dichotomous search, Golden - Section search Fibbonacci search.

(6 hrs)

4- Multi Variable Optimization

Necessary and sufficient conditions for extreme values in general case, Slock variable, Graphical solution, Simplex method, Linear programming and its applications to chemical Engineering problems, Transportation, Blending, Scheduling.

(5 hrs)

EDITORS

Dr. N. B. Nakkash
Ass. Professor

N. J. Saleh
Ass. Professor

N. M. Al-Azawi
Ass. Lecturer

A. T. Jabor
Ass. Lecturer

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