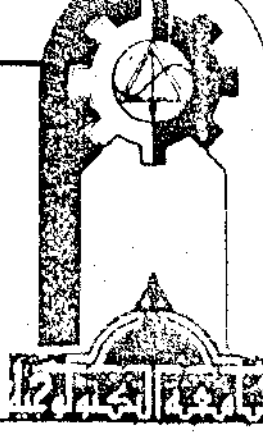
UNIVERSITY OF TECHNOLOGY
CHEMICAL ENGINEERING DEPARTMENT



B.Sc. PROGRAMME IN CHEMICAL ENGINEERING

OUTLINE OF SYLLABUSES
ALLOCATION OF SUBJECTS
&
WEEKLY LOAD

Scientific Committee
1987

INTRODUCTION

Chemical Engineering is distinguished from other branches of Engineering by its strong dependence on chemistry. This enables the chemical engineer to understand processes 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 estabished industry producing chemicals, petroleum products, 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 involve in making innovations in existing operations, doing research, development and analysis of existing plants, technical services, or scale up.

Due to his broad knowledge, the chemical engineer often occupies a dominant position in the above mentioned Industries. He may also apply his knowledge in such driverse 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, physics, 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. The programme branches in the fourth year to three schems in chemical Industries, petroleum and petrocheical Industries and engineering materials with their specialised subjects.

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.

Dr. M.S. Hameed

Head of Scientific

Committee

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University of Technology
Chemical Engineering Department

B.Sc. Chemical Engineering Programme

First years Syllabus

	Subject	Hours/week Theoretical	Practical	Turorial	Units
1-1-	National Education & Scocialism.	1	-	1	3
1-2-	Mathematics(1).	3	-	1	7
1-3-	Material & Energy balance.	3	-	1	7
1-4-	Chemistry.	3	2	1	9
1-5-	Engineering Drawing.	-	-	3	2
1-6-	Mechanics& Strength of Materials.	2	-	1	5
1-7-	Electricity.	1	-	1	3
1-8-	Computers Science.	1	1	-	3
1-9-	Work Shop.	-	6	-	non credit
	Sum	14	9	9	39

Sports and army training= 60 hrs (non credit).

Second Year Syllabus

	Subject	Hours/Week Theoretical	Practical	Tutorial	Units
2-1-	National Education and Socialism.	1	-	1	3
2-2-	Mathematics(2).	2	-	1	5
2-3-	Fluid Mechanics.	3	2	1	9
2-4-	Properties of Materials.	2	1	1	6
2-5-	Computer Programming.	1	2	1	5
2-6-	Thermodynamics.	2	-	1	5
2-7-	Fuel Technology.	1	2	1	5
2-8-	Physical Chemistry.	3	2	1	9
	Sum	15	9	8	47

Six week industrial training.

Third year Syllabus

	Subject	Hours/Week Theoretical	Practical	Tutorial	Units
3-1-	National Education & Socialism.	1	-	1	3
3-2-	Applied Mathematics.	2	-	1	5
3-3-	Unit Operations(1).	3	3	1	9
3-4-	Chemical Engineering Equipments.	1	-	2	4
3-5-	Reactor Design.	3	-	1	7
3-6-	Engineering Economics and Optimization.	2	-	1	5
3-7-	Heat Transfer.	2	2	1	7
3-8-	Statistics and Measurements.	1	-	1	3
	Sum	15	5	9	43

Six week industrial training

Fourth year syllabus

	Subject	Hours/Week Theoretical	Practical	Tutorial	Units
4-1-	National Eduction & Socialism.	1	-	1	3
4-2-	Plant Design.	1	-	2	4
4-3-	Unit Operations(2).	2	1	2	7
4-4-	Process Control.	2	2	1	7
4-5-	Operation & Management of chemical industries	2	-	-	4
	SCHEMES.				
4-6-	Selected Subjects.	2	3	-	6
4-7-	Selected Subjects.	2	-	1	5
4-8-	Project.	1	2	-	4
	Sum	13	8	7	40

Sum of units = 169

Sum of hours = 121

Schemes

Petroleum and Petrochemical

First term	Hours/Week Theoretical	Practical	Tutorial	Units
1- Gas Engineering.	2	-	1	2.5
2- Chemical Processes.	2	3	-	3
Second term				
1- Petroleum Refinery.	2	3	-	3
2- Petrochemical Complexes.	2	-	1	2.5

Engineering Materials

First term				
1- Silicate Technology.	2	-	1	2.5
2- Corrosion.	2	3	1	3

	Hours/Week			
Second term	Theoretical	Practical	Tutorial	Units
1- Polymer Technology.	2	-	1	2.5
2- Composite Materials.	2	3	-	3
Chemical Industries				
First term				
1- Chemical Processes.	2	3	-	3
2- Chemical Industries(1).	2	-	1	2.5
Second term				
1- Biochemical Engineering.	2	-	1	2.5
2- Chemical Industries (2).	2	3	-	3

First Year Curiculum

National Education and Socialism

Weekly load (h/w).

Theoretical	Practical	Tutorial	Units
1	-	1	3

Refer to centralize curriculum

First year curiculum

Subject: Mathematics (1)

Theoretical	practical	Tutorial	Units	
3	-	1	7	weekly load(h/w)

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, theorems about limits, lim sin x/x, continuity.

  $x \longrightarrow 0$

- Differentiation and integration of algebraic functions.

(12hrs)

2- Determinats, Definitions and properties, Solution of systems of equations, (Cramers Rule). (9hrs)

3- Solution of the algebraic equations (second and third order). (3hrs)

4- Transcendental functions: Trigometric, INV, natural logarithmic, expondential, and power functions. sketches. (12hrs)

5- Conic sections (circle,parabolic,Ellipse). (6hrs)

6- Hyperbolic functions: Definitions, Derivatives and integrals. (6hrs)

7- Complex Numbers: Definitions, Argands diagram, product and quotient of two numbers,

$z = r (\cos r + i \sin r)$ and roots of eqn. (6hrs)

8- Applications of integrals

i) Area between two curves.
ii) Volumes.
iii) Length of curve.
iv) Surface areas. (12hrs)

9- Methods of integration.

i) Basic formulas.
ii) Power of trigonometric function.
iii) integrals involve $\sqrt{a^2 - x^2}$, $\sqrt{a^2 + x^2}$, $\sqrt{x^2 - a^2}$
iv) integrals of $ax^2 + bx + C$
v) partial fractions.
vi) Integration by parts.
vii) The substitution U = tan X/2
viii) Improper integrals (conv, and dity). (15hrs)

10- Polar coordinates:
i) The polar coordinates system
ii) graphing of polar coordinates.
iii) derivatives and tangent lines and area in polar. (9hrs)

First year Curiculum

Material and Energy balance

Theoretical	Practical	Tutorial	Units
3	-	1	7 weekly load(h/w)

- Concept of chemical engineering, units, Dimensions, Labels; conversion factors, Temperature, pressure. (15hrs)
- Composition, chemical Analysis, chemical formulas, chemical Equations and stoichiometry. (9hrs)
- Material blance calculations without and with a chemical Reaction, Recycle, By pass and purge calculaation, for steady state, combustion calculation. (24hrs)
- Ideal gas laws; Real gas relationships; vapour pressure, saturation, Material balance involving condensation and vapourization. (15hrs)
- Energy balance; first law of thermodynamics: Enthalpy; heat capacities, their prediction and variation with temperature heat effects. (15hrs)
- Simultaneous mass and energy balance. (12hrs)

First year Curiculum

Subject: Chemistry

Theorotical	Practical	Tutorial	Units	
3	2	1	9	weekly load(h/w)

Part 1 (Analytical and General Chemistry).

1- Introduction (4hrs)
atomic weight. molecular formula
chemical equations, mole concept,
Chemical equilibrium
Stoichiometry.

2- Solutions (8hrs)
Preparation and properties, molarity,
molality, Normality, formality,ppm,
percentages, PH,POH
Solubility.

3- Analytical methods

a. Qualitative Analysis (3hrs)
b. Quantitative Analysis (6hrs)

1. Volumetric Analysis
Acid -Base Titration, Titration, Redox Tiration,
and precipitation Titration and Titration curves.

2- Gravimetric Analysis. (3hrs)
Preciptation analysis and percentage.

3- Instrumental Analysis. (6hrs)
electromagnetic spectrum
caluoremetric analysis.
chromotography
atomic absorption and PH-meters

Part II (Otganic Chemistry)

1- Definition and Aspect of organic. (3hrs)
chemistry and classification of organic compounds.

2- Aliphatic compounds, prepartion and (26hrs)
properties .

Addition and substitution reactions.

Aliphatic derivatives.

3- Aromatic compounds, preparation and properties.
Aromatic derivatives. (20 hrs)

4- Hetrocyclic compounds. (5hrs)
Polymers and Carbohydrates.

5- Organometallic Chemistry. (6hrs)

First year curiculum

Engineering Drawing

weekly load (h/w)			
Theoretical	Practical	Tutorial	Units
-	-	3	2

1- General Information. (2 week)
(Graphic instruments and their use; the alphabet of lines; standarization of paper).

2- Graphic Geometry. (2 Weeks)

3- Orthographic drawing and sketching (3 weeks)
(Orthographic Isometric, Orthoraphic dimetric, oblique frontal diametric).

4- First angle projection, third angle projection. (5 weeks)

5- Constructing athird projection of a model Machine part of fromtwo given projections. (2 weeks)

6- Sectional views and conventions. (5 weeks)

7- Drawing for Engineering design and construction, (6 weeks)
(Making of design, Details, Assembly, Production, construction, andother drawings).

8- Threads; Welded Joints; Nuts. (3 weeks)

9- Inked drawing. (2 weeks)

Total 30 weeks

First year Curiculum

Mechanics and Strength of Materials

Theoretical	Practical	Tutorial	Units	
2	-	1	5	weekly load (h/w)

A- Mechanics

1- Principles of statics (3hrs)

2- Resultants of force systems. (3hrs)

3- Equilibium of force systems. (3hrs)

4- Friction. (2hrs)

5- Centroids and centers of gravity. (6hrs)

6- Frameworks analysis. (4hrs)

7- Forces in space. (4hrs)

8- Principles of Dynamics (Motion, Kinetics, Kinematic). (5hrs)

B- Strength of Materials

1- Internal forces in non-rigid bodeis. (2hrs)

2- Definition of stress and strain, types of stresses and strains, shear stress. (3hrs)

3- Hooks law. (1hrs)

4- Free-body diagrams. (2hrs)

5- Stress-strain Diagrams, stress-strain Diagram for ductile-and brittle materials. (3hrs)

6- Proportional limits, elastic limit, stiffness, elasticity, plasticity, toughness, Resilience, hardness,posisons ratio bulk modulus. (4hrs)

7- Composite stress. (3hrs)

8- Thermal stress. (3hrs)

9- Torsion and power transmision by shaft. (5hrs)

10- Beam, shear and moments in beams (4hrs)
deflection.

First year Curiculum

Electricity

Theoretical	Practical	Tutorial	Units	
1	-	1	3	weekly load(h/w)

1- Semiconductors equipments. (2hrs)

2- Rectifiers and Detectors. (3hrs)

3- Electronic amplifiers. (4hrs)

4- D.C. Ciruits. (3hrs)

5- D.C. generators and motors. (3hrs)

6- A.C. circuit. (5hrs)

7- Polyphases circuits. (2hrs)

8- Transformers and Induction motors. (4hrs)

9- Starters. (2hrs)

10- Integrated circuits, Measuring Instruments, Tranducers,Transmeter. (3hrs)

First year curriculum

Computers Science

Weekly load (h/w)			
Theoretical	Practical	Tuoterials	Units
1	1	-	3

2 hr weekly during 1st and 2nd semesters. Total of 60 hrs per academic year.

	Lecture(hr)	Practical(hr)
1- man and machine. - the need of data processing. Historical Background. - Electronic computer generations. - Kinds of computers: MICROS, MINIS, and MAIN-FRAME.	3	1
2- Electronic Computers. - Computer Handware and accessores. - Computer Software.	4	2
3- Binary system, commands. machine language. Programming language: High level and low level.	8	2

First year Syllabus

Work Shop

Weekly load (h/w)			
Theoretical	Practical	Tutorial	Units
-	6	-	non-credit

Sheet metal, Forging, Fitting, Machining, Electricity, Carpentury, Automotive mechanics, Welding, Foundary.

	Lecture(hr)	Practical(hr)
	7	5
- Algorithim - Making Decisions. - LOOPS. - EXAMPLES.		
- Course in Programming using. BASIC Language.	10	14
- Application of computers in various Fields.	4	-
Application of Micros.		
Total	36	24

Second year curiculum

National Education and Socialism

Weekly load (h/w)

Theoretical	Practical	Turorial	Units
1	-	1	3

Refer to Centralize Curiculum

Second year curiculum

Mathmematics (2)

Theoretical	Practical	Tutorial	Units
2	-	-	5

Weekly load(h/w)

I- Partial differentiation. (10hrs)

- Functions of two more variables.
- Limits and continuity.
- Partial derivatives.
- Chain rule.
- Gradients, directional derivatives and tangent planes.
- Higher order derivatives.
- Maxima, Minima and saddle points.
- Langrange multipliers.

II- Complex Algebra. (10hrs)

- Conjugate number.
- Demoires theorem.
- The complex variables.
- Derivation of complex variable.
- Analytic Functions.
- Integration of functions of complex variables and cauchys theorem.

III- Multiple Integrals. (8hrs)

- Double Integrals.
- Area.
- Triple Integrals in rectangular coordinates.
- Physical application in the three dimensions.

IV- Vector Analysis. (8hrs)

- Vector component and the unit vector i and j.
- Addition and subtraction of vectors.
- Multiplication of vectors.
- Quadratic surfaces.
- Greens theorem.
- Stockes's theorem.

V- Functions and difinite integrals. (6hrs)

- The Error function.

The Gamma function.

- The Beta function.
- Evaluation of definite integrals.

VI- Infinite Series. (10hrs)

- Power series of Functions.
- Talyors theorem.
- Convergence of power series.
- Integration,differentation,multiplication and division.
- Fourier series, even and odd functions, half range expansion, periodic functions.

VII_ Materices. (8hrs)

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

Second year Curiculum

Fluid Mechanics

Theortical	Practical	Tutorial	Units	
3	2	1	9	Weekly load(h/w)

1- Dimensional analysis and units. (6hrs)

(S.I. units, English units,C.G.S. units),

(Normal method, II-Theorm).

2- Type of fluid and properties of fluid. (2hrs)

A-On basis of pressure effect:

- Incompressible.
- Compressible.

B- On basis of shear force effect:

- Newtanian.
- Non - Newtanian.

C- Type of fluid,basis on the state of fluid:

- Static; tanks head, Manometers.
- Dynamic.

3- Incompressible Fluid; Non-Newtanian Fluid. (6hrs)

a- Derivation of Bernulli equation.

b- Correction to Bernulli equation.

c- Effect of friction.

d- Calculation of friction in straight pipe and in fitting.

e- Calculation of horsepowers.

f- Equipment;

Kind of pump.

Valves.

Fitting.

4- Compressible Fluid. (14hrs)

a- Introduction, different between comp.

and Incomp. fluid.

b- Derivation of General equation of compressible.

c- Calculation of friction.

d- Calc. of work of comp.
1- for Isothermal comp.
2- for Adiabatic comp.

e- Cale. of electric consumption and motor power

of compressor.

f- Equipement: compressor, blower, vans.

5- Newtanian fluid. (6hrs)

a- Definition.

b- Calculation of friction.

6- Non-Newtanian fluid. (6hrs)

a- Definition.

b-Different from non-Newtanian.

c- Calc. of friction.

7- Flow Measurement. (12hrs)

Orific, Venture, pitot tube

8- Applied Fluid Mech. to Ch. Eng. processes. (8hrs)

(Cale. of pipe net-work between equipment)

1- For Incomp.
2- For comp.

9- Flow of fluid through granular beds and (10hrs)

packed colum.

10- Mixing. (6hrs)

11- Two phase flow. (4hrs)

Second year Curiculum

Properties of Materials

Theortical	Practical	Tutorial	Units
2	1	1	6 weekly load (h/w)

1- Atomic-and crystal structure. (3hrs)

2- Miller indices X-Ray diffraction, (2hrs)
effects of radioactives on the Engineering materails.

3- Imperfection in crystals. (2 hrs)

4- Atoms movements in Engineering materials. (2hrs)

5- Thermal proprties of Engineering materials. (3hrs)

6- Electrical proerties of Engineering materials. (3hrs)

7- Solid solution. (2hrs)

8- Phase digrams. (1hrs)

9- Ferrous metals and their alloys. (4hrs)

10- Non-Ferrous metals and their alloys. (4hrs)
(copper and its alloys), aluminum and its
alloys, magnesium alloys,their properties and uses.

11- Corrosion (definition and importance of (8)
corrosion, types of corrosion, corrosion preventation.

12- Polymers (definition, classification, (10hrs)
molecular weight distribution, effect of
molecular weight on the properties of
polymers, types of polymers and rubbers and their uses.

13- Ceramics (plastic-and non-plastic raw materials, types-and structure of clays, action of heat on clays SiO_2-Al_2O_3-phase diagram, differential thermal analysis (DTA) Refractories and glasses. (10hrs)

14- Phase changes in materials. (2hrs)

15- Composite materials. (2hrs)

Second year Curiculum

Computer Programing

Theortical	Practical	Tutorial	Units
2	1	2	7 weekly load (h/w)

1-Introduction (2hrs)

modes of operation, statements and commands control keys, editing, LIST, RUN, NEW, DELETE, COLOR, error messages.

2- Arithemtic (2hrs)

constants, variable, arithemtic and logical operators, precendence rule, use of brackets, library functions, arithemtic statements.

3- Input output. (2hrs)

Keyboard and CRT,INPUT,PRINT,READ, DATA, TAB, SPC, control characters.

4- Control statments. (5hrs)

Go TO, IF THEN, looping, FOR,NEXT, multiple loops, ON GOTO, a

Application in series evaluation, statistics, and Newton-Raphson iteration.

5- Subscripted variables. (5hrs)

arrays and subscripts, DIM, one-dimensional arrays, two-dimensional arrays,applications in numerical methods.

6- Subprograms. (3hrs)

types of subprograms, functions, DEF FN, subroutines, GOSUB RETURN, applications.

7- Peripheral operations

Printers, LLIST, LPRINT, casette recorders floppy drives, FILES, SAVE, LOAD, MERGE, file 1/o operations.

8- Graphics

CRT, types of screens, pixels, SCREEN, PSET (4hrs) LINE, CIRCLE, DRAW, applications in cruve plotting.

9- Other computer languages. (4hrs)

FORTRAN, structured programming, fourth-generation languages, application packages, artificial intelligence.

Second year Curiculum

Theromdynamics

Theoretical	Practical	Tutorial	Units
2	-	1	5 weekly load(h/w)

1- Introduction (2hrs)

Fundamental quatities. Time, length, Mass, Force, Temperature, Secondary quatities, Volume, pressure, work, Energy Heat.

2- First Law and other basic concepts (4hrs)

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.

3- Volumetric properties of pure fluids. (8hrs)

The PVT behaviour of pure substances, the virial equation, The ideal gas, Cubic equation of state, Generalized correlation and the Acentric factor.

4- Heat Effects. (6hrs)

Heat capacities of gases as a function of temperature, soilds and liquids, heat change accompanying phase change, heat of formation, combustion and reaction, heat effects of industrial reactions.

The second law of thermodynamics. (6hrs)

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

Thermodynamics properties of fluids. (10hrs)

Relationships among the thermodynamic 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.

Refrigeration and liquefication. (12hrs)

Refrigeration cycles (carnot,Air,Vapor-compression) and comparisons,Choice of refrigerant, Absorption,Refrigeration, the heat pump, liquefaction process.

Phase equilibrium. (6hrs)

The nature and criteria of equilibrium, Binary system, vapor pressure of an ideal solution and non ideal solutions, Henrys law, Activity and Activity. coefficients.

Chemical Reaction equilibrium. (6hrs)

Thermodynamics of ideal gases and mixtures, Derivation of the general equilibrium expression, Chemical equilibrium of ideal and non-ideal gases,

Determination of equilibrium constant, Reaction egilibrium in solutions. Standard Gibbs free energy and calculations, spontainity of chemical reaction, effect of temperature on chemical equilibrium. Influence of temperature on Gibbs free energy change.

Second year Syllabus

Fuels Technology

Theoretical	Practical	Tutorial	Units	
1	2	1	5	weekly load(h/w)

1- Energy and Fuels.	(3hrs)
2- Calssification of Fuels.	
3- Evaluation of crude oil.	(4hrs)
4- Production of Petroleaum fractions.	
5- Motor Gasoline.	(7hrs)
6- Kerosine and Jet Fuels.	
7- Diesel Fuels.	
8- Fuel oils.	
9-Lubricating oils and Asphalte	
10- Gaseous Fuels.	(3hrs)
11- LPG, LNG.	
12- Combustion calculations.	(4hrs)
13- Combustion characteristics.	
14- Gaseous Fuels burners.	(6hrs)
15- liquid Fuels burners.	
16- Combustion in Furnaces and Biolers.	(3hrs)
Total	(30hrs)

Second year Curiculum

Physical Chemistry

Theoretical	Practical	Tutorial	Units	
3	1	1	9	weekly load(h/w)

1- The description of ideal and real behaviour of gases and the related equations. (9hrs)

2- Change of state:
one component systems and binary liquid mixtures.
liquid -vapour composition and effect of temperatures,
and solubility of gases in liquids. (12hrs)

3- Surface Chemistry;
The physical properties of surfaces between different phases, and related theories and calculations. (15hrs)

4- Thermochemistry:
Enthalpies of chemical changes and reactions of compounds and solutions and its dependence on temperature. (6hrs)

5- Chemical Kinetics:
The rate of chemical reactions, rae constants, order of reactions in static and flow systems, homogenous aus and heterogenous catalysis and enzyme reactions and kinetics. (24hrs)

6- Electrochemistry
Properties and theories of electrochemical systems, and solutions of electrolyts. (12hrs)

7- Electochemical Cells:
Properties and reactions of electrodes and different type of cells, oxidation-reductions reactions, Electrolysis and corrosion. (12hrs)

Third year curiculum

National Education and Socialism

Weekly load (h/r).

Theoretical	Practical	Tutorial	Units
1	-	1	3

Refer to centralize curiculum

Third year Curiculum

Applied Mathematics

Theoretical	Practical	Tutorial	Units
3	1	-	7

Weekly load(h/w)

I- Ordinary differential equation. (16hrs)

- Solution of first order differntial equations.
- Solution of second order differential equations.
- Higher order differential equations.
- Simultaneous differential equations.
- Application for chemical engineering.

II- Solution of differential equation by series. (8hrs)

methods

- Simple series solutions.
- Method of frobeins.
- Bassel's equation.
- Application for chemical engineering.

III- The Laplace Transformation. (12hrs)

- The laplace transform.
- 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 functions, periodic function trigonometric.

IV- Partial differential Equations. (8hrs)

- 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.

V- Numerical analysis. (16hrs)

- The difference operators.
- Interpolation.
- Finite difference equations.
- Differentiation and Integrations.
- Solutions of first and second order differential equations.
- Systems of differential equations.
- Applications for chemical Engineering.

Third year curiculum

Units Operations (1)

Theoretical	Practical	Tutorial	Units	
3	3	1	9	Weekly load (h/w)

- Mechanical and physical separation processes. (6hrs)
  - Settling and sedimentation
  - Filtration (6hrs)
  - Centerifugal separation (6hrs)
  - Particulate solid. (3hrs)
  - Mechanical size reduction. (3hrs)
- Mass Transfer Operations
  - Diffusion. (15hrs)
  - Definition of mass transfer Molecular and convective components of mass flux
  - Diffusion in gases and liquid.
    - Steady state diffusion of A through B.
    - Steady state equimolar diffusion.
    - Maxwell theory of diffusion for gas and Liquid.
  - Steady state diffusion in multicomponent mixture.
  - Calculation of diffusivity.
  - Diffusion through varying area.
  - Diffusion of solid.
  - Differential equation of continuity equation of mass transfer.
  - Unsteady state diffusion.
- Theories of mass transfer and mass transfer coefficients. (9hrs)

- Enthalpy- composition diagram.
- Multi compoment plate-to-plate-calculations.
- Lewis-Metheson method, Thiele-Gebbes and theta Method.
- Azeotropic and extractive-distillation.
- Steam distillation.
- Absorption and distillation efficiency.
- Distillation in packed tower.

- Two-Film theory
- Interphase theories of mass transfer

  Higbie, Danckwerts and other.
- Overall and individual mass transfer coefficients.
- Dimensional analysis in mass transfer.

Absorption (15hrs)

- Vapour-Liquid equilibrium.
- Mass transfer coefficients (wetted-wall towers)

  in packed towers.
- Types of Towers.
- Absorption in plate and packed Towers.
- Design in packed tower.
- Calculation of height of transfer units.
  (overall and individual)
- Calculation of number of transfer unit.
- Absorption in dilute mixture.
- Absorption in concentrated mixture.
- Design of plate towers.
- Non- isothermal absorption.

Distillation (27hrs)

- Vapour-liquid equilibrium.
- Method of distillation.
- Continuous distillation.
- Lewis-Sorel method.
- Mc cabe-Thiele method.
- Feed condition,feed plate location, Multiple feed and

  side stream, Live stream and tray efficiency.
- Fensks and underwood equations.
- Gillilands method.
- [illegible] Tower.

Third year Curiculum

Chemical Engineering Equipments

Theoretical	Practical	Tutorial	Units	
1	-	2	4	Weekly load (h/w)

Part A

1- Process planning. (6hrs)

- Schedualing and flow sheet desing.
- Flow sheet types and designation.
- Block diagram.
- process flow sheet.
- piping and instruments diagram.
- Utility flow sheet.
- Equimpment layout and plot plan.
- Application of the above in tutorials.

2- Piping net works and pumps. (6hrs)

- pipe fittings, valves, steam traps etc.
- piping design standards.
- piping material and selection.
- pump specifications and data sheets.

3- Vessels and Tanks. (6hrs)

- Types of vessels. Flash drums, LPG tanks...etc.
- Criteria in vessel design.
- Stress considerations.
- Design of tall vertical vessels.
- Design of pressure vessels.

4- Heat Transfer Equipments. (6hrs)

- Types of exchangers and applications.
- Exchanger ratings, exchanger design.
- Exanchanger specification sheets.
- Furnaces.
- Convection and radiation zones.
- Types of fuels,burners and arrangements.
- Steam boilers, types of boilers.

5- Mass Transfer Equipments. (6hrs)

- Types of columns. plate and packed.
- Types of plates and packings.
- Design features.
- Pressure drops in columns.

Part B

Complete equipment design of each of the following units:

1- Pressure Vessel

Flash drum, gas-liquid separator, LPG storage tank, cyclone separators ..... etc.

2- Heat Exchanger

Tube and shell heat exchanger, plate heat exchanger, boilers, furnaces ....etc.

3- Mass Transfer Equipment

Distillation columns, absorbers, extractors, dryers ..... etc.

- Internal transport processes, reactions (6hrs)
and diffusion in porous catalyst.
- The design of hetrogeneous catalytic (8hrs)
reactors, packed bed reactors, isothermal and
adiabatic operations.
- Slurry reactor. (4hrs)
- Fluidized bed reactor. (4hrs)
- Trickle bed reactor. (4hrs)
- Thermal characterstics of (2hrs)
catalytic reactor.

Third year Curiculum

Reactor Design

Theoretical	Practical	Tutorial	Units	
3	-	1	7	Weekly load(h/w)

- Reviw of kinetics of homogeneous reactions. (4hrs)
- Classification of reactor, choico of reactor type, choice of process conditions. The design of homogeneous reactors. (4hrs)
- Batch reactors, basis design equation, time, isothermal and non-isothermal operations. (8hrs)
- Tubular reactors, basis design equation, and non-isothermal operations, pressure drop. (8hrs)
- Continuous stirred tank reactors,ideal mixing,residence time,design equations, autothermal operation. (8hrs)
- Non-steady flow (semibatch) reactors, recycle reactors. (4hrs)
- Comparison of reactors for a simple and multiple reactors. (4hrs)
- Heterogeneous process, catalysis, adsorption (BET), biochemical reactions. (8hrs)
- Rate equations for fluid-solid catalytic reactions. (8hrs)
- External transport in hetrogeneous reactions,mass and heat transfer correlation for fixed bed, fluidized bed slurry and trickle bed reactors. (6hrs)

Third years Curiculum

Engineering Ecomnomics and Optimization

Theoretical	Practical	Tutorial	Units	
2	-	1	5	Weekly load(h/w)

Part A

1- Introduction to process economics. (2hrs)

2- Elements of economic analysis. (8hrs)

Money value,type of interest and interest compounding profitability analysis, Depreciation, Continuous cash flow, Disconunted cash flow.

3- Visibility studies(Technical and Economic studies). (4hrs)

4- Cost Estimation. (10hrs)

Equipment cost, fixed cost manufacturing cost, plant cost.

5- Economic Design Criteria. (10hrs)

Profitability studies present value of future Money complition for capital, evaluation of design criterion Accounting for risk Economic life of processes.

Part(B)

1- Introduction to process optimization. (2hrs)

2- Organization of Optimization Problem system models. (4hrs)

3- Single Variable (12hrs)

Analytical method, Numerical method, graphical method numerical search,Bounded function open ended function, Direct search, Dichotomous search, Golden-section search Fibbonacci search.

4- Multivariable Optimization (8hrs)

Necessary and sufficient conditions for extreme values in general case, sldck variable and coustrained variation,Graphical solution, simplex method, linear programming and its applications to chemical Engineering problems (Transporation Blending, scheduling).

Third year Curiculum

Heat Transfer

Theoretical	Practical	Tutorial	Units	
2	2	1	7	Weekly load(h/w)

1- Modes of heat transfer. (2hrs)
Material properties of importance in heat transfer.

2- Steady state heat conduction in one (12hrs)
dimension (plane wall, Radial systems, Heat source systems, Boundary surrou-nded by fluids, Overall heat transfer coefficient, Extended surfaces conduction-convection systems, Fins).

3- Principles of convection. Transport (14hrs)
equations. Fluid mechansing aspect of convection.
Laminar boundary layer. Thermal boundary layer. Turbulent boundary layer, Empirical and practical relations for pipe and tube flow. Flow normal to single and tube banks.

4- Heat exchangers. Various types and their (8hrs)
general characteristics. Fouling factor. Heat exchanger mean temperature differences. Co-current and counter current flow. Parallel and counter current flow. Parallel and series arrangements. Pressure drop calculations.

5- Shell and tube exchangers. Types and various specifications. Design calculations by conventional method and by effectiveness and (NTU) method. Optimum design calculation. (4hrs)

6- Condensation and boiling heat transfer. condenstation of single vapour. Design calculations for condenser. condenser-subcooler and Desuperheater-condenser. (6hrs)

7- Radiation and furnace design. Radiation properties. Shape factor. Heat exchanger for non black bodies. Parallel planes. Shields. Gas radiation. Boiler Design. (10hrs)

8- Unsteady state heat transfer. (4hrs)

Total (60hrs)

Third year Curiculum

Statistics and Measurements

Theoretical	Practical	Tutorial	Units
1	-	1	3

Weekly load(h/w)

Introduction (2hrs)

Statistics, population and sample,descriptive and inductive statistics, discrete continuous variables, graphical representation of data.

Measurements. (4hrs)

absolute and relative measurements, independent and dependent variables, calibration, effects of environmental conditions, applications in measurement of physical properties.

Sampling. (2hrs)

random sampling, sampling methods, sampling of solids liquids, and gases, sampling error, sample size.

Frequency Distributions. (2hrs)

raw data, arrays, frequency, frequency distr-ibuttion table, graphical representation of freq-uency distributions.

Measures of central tendency. (2hrs)

arithemtic mean, median, mode, geometric mean, harmonic mean, root mean square.

Measures of dispersion.

dispersion, the range, mean absolute deviation, standard deviation absolute and relative dispersion, coefficient of variation, standardized variables.

7- Standard distibutions. (2hrs)

The normal distribution, binomial distribution, Poisson distribution, table of areas under normal distribution curve.

8- Chi-square distribution. (2hrs)

Chi-square distribution, confidence intervals, degrees of significance test, chi-square test, freedom, goodness of fit.

9- Curve fitting. (4hrs)

Curve fitting, method of least squares, straight line relation, straight line forms, polynomials, regression. correlation coefficient.

10- Errors. (2hrs)

types of errors, error estimation, propagation of errors.

11- Measuring instruments. (4hrs)

Temperature, pressure, flow rate, level, composition.

Fourth year curiculum

National Education and Socialism

Weekly load (h/r)

Theoretical	Practical	Tutorial	Units
1	-	1	3

Refer to centralize curiculum

Fourth years Syllabus

Plant Design

Weekly load (h/w)			
Theoretical	Practical	Tutorial	Units
1	-	2	4

1- Introduction: to include:

a-Reviewing the different methods of manufacturing the product, comparing them by refering to scientific references and then choosing the suitable one.

b- Brief description of chemical and physical processes involved in the chosen method and listing main equipment in reference to the flow sheet.

c- A study to justify the production capacity of the plant.

2- Heat and material balance for all streams. Energy balance of all equipment, listing summary of temperatures plus magnitudes of energy and flowrates.

3- Design of main equipment; one in each of the following fields:

a- Mass transfer.

b- Heat transfer.

c- Reactor.

d- Mechanical equipment(Pressure tank, pipeline network.. etc). Then outlying capacity of remaining equipment.

e. Drawing the plant layout.

4- Other requirements: to include:

a- Estimating equipment costs, fixed and operating cost, and cost of unit product.

b- Choosing and justifying geographic location of the plant.

c- Discussing effect of plant and products on the environment. Suitable treatments are to be suggested, to overcome these effects.

d- Choice of suitable control devices for used equipment.

Fourth year Curiculum

Unit Operations (2)

Theoratical	Practical	Tutorial	Units	
2	1	2	7	Weekly load (h/w)

1- Boundary layer and analogies. (10hrs)

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

2- Evapration

2.1. Heat transfer in evaporators.

2.1.1. Heat transfer coefficient.

2.1.2. Boiling at submerged surface.

2.1.3. Forced convection boiling.

2.1.4. Vacuum operation.

2.2. Multiple-Effect Evaporators.

2.2.1. Gereral principles.

2.2.2. The calculation of multiple-effect systems.

2.2.3. Comparison of forward and backward feeds.

3- Extraction

3.1. The mixing of Liquid-Liquid systems.

3.2. Liquid-Liquid extraction.

3.2.1. Application.

3.2.2. Design consideration.

3.2.3. Equilibrium conditions.

3.3. Calculation of the number of theoratical stages in extraction operation.

3.3.1. Concurrent contact with partially miscible solevents.

3.3.2. Co-current contact with immiscible solvents.

3.3.3. Counter current contact with immiscible solvents.

3.3.4. Counter current contact with partially miscible solvents.

3.4. Continuous Extraction in Columns.

4- Humidification and dehumidification and cooling tower. (14hrs)

4.1. Humdification terms.

4.2. Humdity data for air-water system.

4.2.1. Temperature-Humidity chart.

4.3. Addition of liquid or vapour to a gas.

4.4. Dehumididication.

4.5. Water cooling.

4.5.1.1. Height of packing.

4.5.1.2. Change in air condition.

4.5.1.3. Evaluation of heat and mass transfer coefficients.

4.6. Systems other than Air-water.

5- Drying (6hrs)

5.1. Introduction and general priniciples.

5.2. Rate of drying.

5.2.1. Drying periods.

5.3. The mechanism of moisture movement during drying.

5.4. Classification and selection of dryears.

6- Crystallization (8hrs)

6.1. Introducation

6.2. Growth and properties of crystals.

6.2.2. Nucleation

6.2.3. Crystallization rate.

6.2.4. Effect of impurities on crystal formation.

6.2.5. Effect of temperature on solubility.

6.2.6. Fractional crystallization.

6.2.7. Caking of crystats.

6.3. Crystallizers.

6.3.1. Bath crystallizers.

6.3.2. Continuous crystallizers.

Fourth year Curiculum

Process Control

Theoretical	Practical	Tutorial	Units	
2	2	1	7	Weekly load(h/w)

1- Process dynamics and transient response of the systems.

- Review of Laplace transform.
- Introduction to automatic feed back control systems in chemical process industries.
- Fundemental of process dynamics and transient response characterization.
- 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.

(20hrs)

2 - Industrial controller actions.

- Introduction to different industrial controller actions and their dynamic characteristics.
- Selection criteria for various control modes.
- Final control elements, their characteristics and sizing.
- Dynamic and control of chemical reactor system.

(10hrs)

3 - Characteristics of the closed loop systems.

- Overall closed loop transfer functions and block diagram algebra.

- Transient response of simple closed loop control systems.
- Stability of control systems.
- Introduction to the frequency response analysis and design techniques.

(20hrs)

4- Dynamic and control of some chemical processes.

- Dynamic and control of heat exchangers.
- Dynamic and control of Distillation columns.
- Introduction to computer control of chemical processes.

(10hrs)

Fourth year Curiculum

Operation and Management of Industrial

Theoretical Practical Tutorial Units

System Management (8hrs)

Utilities

General requirements for utilities supply and distribution.

Steam uses in chemical plants removal and utilization of condensate problems of steam pipes net work.

Industrial water and Effluent Treatment classification of water according to the international(PL scale)

water and sludge treatment systems

Industrial processes avaiable for:

GPR Gross Particulate Removal

SPR Suspended Particulate removal

DMR Dissolved matter removal

Sludge treatment systems.

Compressed air and Nitrogen specification, distribution and uses in chemical plants other utilities (cooling conditioning, ventillation, Humidification,electricity..).

Environment Pollution Control (8hrs)

Dangers of pollution -Importance of environment preservation.

Effect of weather on atmosphere pollution

Industrial processes available for purification of waste gases.

Measurments for pollution control

Water Pollution.

Gase studies.

Hazards In Chemical Plant Operation (8hrs)

Identification of Hyzardous atmosphere sources of hazards in industry.

Hazard evaluation in industrial processes.

Fault tree analysis.

Saftey in the operation of chemical plants.

Loss Prevention Concepts and Studies in dustry (8hrs)

Sources and evaluation of loss in industry

Reduction of loss in industry

Case studies.

Quality Control (6hrs)

What is quality-Design and production quality-Quality and cost-importance of quality control requirement of quality control.

Reliability Engineering Concepts and Application (6hrs)

Reliability definition. Age cycle, Reliability and cost, Reliability block diagram.

Reliability evaluation of industrial systems.

Methods of improving the reliability of industrial system.

Definition of Availabitity.

Factors affecting the availability of industrial system.

method of improving availability of chemical plants.

Availability evaluation of chemical plants case studies.

Maintenance (6hrs)

Type of maintenance

Problems of maintenance

Maintenance programming.

Introduction of Production Planning and Control (6hrs)

Importance of good production planning, factors affecting production planning charting Types and uses forecasting, schedulling, linear programming critical path analysis case studies.

Fourth year curiculum

Petroleum and Petrochemical Schems

* Gas Engineering (First term only)

	Theoretical	practical	Tutorial	Units
Weekly load (h/w)	2	-	1	5

- Physical and thermodynamic properties of gases.
- Production of gas.
- Compression and expansion.
- Separation processes.
- Dehydration.
- Sweetening.
- Liquifaction.

* Chemical Processes (First term only)

	Theoretical	Practical	Tutorial	Units
Weekly loads	2	3	-	6

- The main petrochemical processes for production basic raw material and intermediates for petroleum and Petrochemical Industries such as:

  Cracking and steam cracking.

  Oxidation.

  Dehydrogenation and hydrogenation.

  Chlorination.

Alkylation.

Sulphonation.

Polymerization.

Polycondensation.

- Other related chemical processe.

Fourth year curiculum

Petroleum and Petrochemical Scheme

* Petroleum Refinery (second term only)

	Theoretical	Practical	Tutorial	Units
Weekly load (h/w)	2	3	-	6

- Pretreatment of crude oil.
- Tubular furnaces.
- Crude oil distillation and stabiliza ion of petroleum fractions.
- Thermal and catalytical cracking.
- Reforming processes.
- Desulfurization.
- Lube oils processing.
- Utilities in the refinevy.

* petrochemical Complex (second term only)

	Theoretical	Practical	Tutorial	Units
Weekly loads (h/w)	2	-	1	5

- Low Olefins, Plastics.

  Diolefins, Rubber.

  High Olefins, Detergents.

  Aromatics, Systhetic Fiber.

  H2 and CO.

  Utilities in petrochemical complexes.

Fourth year curiculum

Engineering Materials Scheme

* Silicate Technology (First term only)

	Theoretical	Practical	Tutorial	Units
Weekly load	2	-	1	5

Structural forms of silicates, ceramics raw materials, cermics processes, preparation of raw materials, moulding, drying and firing. Ceramics, product, ordinary bricks, refractores, porcelains, cement and glass.

* Corrosion (First term only)

	Theoretical	Practical	Tutorial	Units
Weekly load	2	3	1	6

Corrosion definition and importance, mechanism of electrochemical corrosion, types, the electrochemical theory of coorosion. Corrosion of iron and steel in aqueous environment, effect of dissolved oxygen, effect of bacteria, effect of galvanic coupling, effect of velocity, effect of dissolved salts, natural water, metallurgical factors, heat treatment.

*Polymer Technology (Second term only)

	Theoretical	Practical	Tutorial	Units
Weekly load	2	-	1	5

Introduction, classifications of polymers, polymerization and the effect of kinetics on the molecular weights. Molecular weights and its distribution and methods of determination. Heat of softening and the glass-transition temperature and the factors affecting it.
Physical properties and molecular factors affecting it. Modification of properties according to the applications requirements.

* Composite Materials

	Theoretical	Practical	Tutorial	Units
Weekly load	2	3	-	6

Definition, timber and polywood, fiber-reinforced materials, Dispersion-strengthened metals, cermets and polymers, concrete, glazes and enamels.

Fourth year curiculum

Chemical Industries Scheme

* Chemical Processes (first term only)

	Theoretical	Practical	Tutorial	Units
Weekly loads (h/w)	2	3	-	6

- Oxidation, Sulphonation, Nitration, Alkylation Halogenation, Polymerization, Condensation Polymerization, Hydrogenation and dehydrogenation lonization, Hydrolysis and dehydration, Electrochemical Process, Chemical decomposition.

*Chemical Industries (1) (first term only)

	Theoretical	Practical	Tutorial	Units
Weekly loads (h/w)	2	-	1	5

A. Fertilizer and acids

- Development of Ferilizer Industries.
- Manufacture of ammonia gas.
- Manufacture of urea fertilzer.
- Phosphoric acid.
- Manufacture of phosphoric fertilizer.
- Sulphuric acid.
- Manufacture of sulphuric fertilizer.
- Nitric acid.
- Hydrochloric acid.

B- Petrochemical Industries.

- Detergents.
- Industrial fibers.

- Organic acids.

- Polymers.

- Glycols and esters.

C- Explosive materials Industries

- Explosives Industry.

- Powder Industries.

- Black powder.

- Spherical powder.

- TNT.

Fourth year curiculm

Chemical Industries Scheme

* Biochemical Engineering (second term only)

	Theoretical	Practical	Tutorial	Units
Weekly loads (h/w)	2	-	1	5

- Introduction.
- Kinetics of substrate utilization.
- Kinetics of enzyme-Catalysed reactions, and enzyme mechanisms.
- Transport phenomena in biochemical systems.
- Design and analysis of biological systems.
- Applications of biochemical engineering.

* Chemical Industries (2)

	Theoretical	Practical	Tutorial	Units
Weekly loads (h/w)	2	3	-	6

A. Food Industry.

- Food elements.
- Canning.
- Cooling and freezing.
- Fermentation.
- Sugar and dates Industry.
- Oils and soap Industry.
- Carbonized liquor.
- Food Simulation.

B- Dyes and Pigments

- Natural.
- Synthetic.
- Direct Dyes.
- Basic Dyes.
- Acidic Dyes.
- Disperse Dyes.
- Active Dyes.
- Theories of Dying.
- Reactions of Dyes manufacture.
- Reactions of colourings manufacture.

Fourth year curiculum

Project

	Theoretical	Practical	Tutorial	Units
Weekly load	1	2	-	4

1- Object of project

2- literature survey and related theoretical background.

3- Design and erection of required apparatus and practical experimentation, or preparation of planned computor programs and execution.

4- Analysis and discussion of results.

5- Conclusions and recommendations.

Note:

Projects employing computer usage only should be either:

1- Developments of equations, theories and deduction of practical relations of scientific use.

2- Design studies to obtain optimum solution for a certain problem with multiple variables.

3- Preparation of programs and systems of multiple applications in Chemical Engineering with wide scientific use.