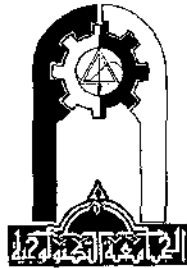


Ministry Of Higher Education

**University Of Technology
Chemical Engineering Department**



**B.Sc PROGRAMME
IN
CHEMICAL ENGINEERING**

**OUTLINE OF
SYLLABUSES ALLOCATION OF SUBJECTS
AND
WEEKLY LOAD**

2003 -2004

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

The formal course work for B.Sc. programme involves mathematics, including both analysis and computer application, chemistry, mechanics, electricity chemical engineering principles and practice subjects including fluid dynamics, heat, unit operation, chemical reactor design, thermodynamics, and chemical processes. In addition the programme involves English Language which is essential for any engineering student to enable him/her to benefit from thousands of textbooks and periodicals.

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 subjects which are taken by the chemical engineering students during their four years study.

Prof. M. A. Zablouk
Chairman of Chemical Eng. Dept.

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Subject Symbol	Subject	Hours / Week						Units
		First Term			Second Term			
		Theoretical	Practical	Tutorial	Theoretical	Practical	Tutorial	
CE. 111	English Language	2	-	-	2	-	-	4
CE. 121	Mathematics	3	-	1	3	-	1	6
CE. 141	Principle of Chemical Engineering	3	-	1	3	-	1	6
CE. 221	Chemistry	3	2	1	3	2	1	8
CE. 131	Engineering Drawing	1	2	-	1	2	-	4
CE. 231	Mechanics and Strength of Materials	2	-	1	2	-	1	4
CE. 331	Electrical Technology	1	-	1	1	-	1	2
CE. 321	Computer Science	2	2	-	2	2	-	6
CE. 431	Workshop	-	6	-	-	6	-	4
Total		17	12	5	17	12	5	44

Number OF Hours / Week

First Term	Second Term
34	34

Subject Symbol	Subject	Hours / Week						Units
		First Term			Second Term			
		Theoretical	Practical	Tutorial	Theoretical	Practical	Tutorial	
CE. 112	English Language	2	-	-	2	-	-	4
CE. 122	Mathematics	2	-	1	2	-	1	4
CE. 142	Fluid Flow	3	2	1	3	2	1	8
CE. 132	Properties of Materials	1	-	1	1	2	1	3
CE. 222	Computer Programing	2	2	-	2	2	-	6
CE. 342	Fuels Technology	1	2	1	1	-	1	3
CE. 242	Thermo dynamics	2	-	1	2	-	1	4
CE. 232	Physical Chemistry	2	2	1	2	2	1	6
Total		15	8	6	15	8	6	38

Number OF Hours / Week

First Term	Second Term
29	29

A-Unit Operation OF Chemical Industry Branch

Subject Symbol	Subject	Hours / Week						Units
		First Term			Second Term			
		Theoretical	Practical	Tutorial	Theoretical	Practical	Tutorial	
CE. 133	Applied Mathematics	3	-	1	3	-	1	6
CE. 143	Mass Transfer	3	2	1	3	-	1	7
CE. 233	Statistics and Instruments Measurement	1	1	1	1	-	1	3
CE. 243	Reactor Design	3	-	1	3	-	1	6
CE. 343	Heat Transfer	3	-	1	3	2	1	7
CE. 443	Equipment Design by Computer	2	1	-	2	1	-	6
CE. 543	Biochemical Engineering	2	-	1	-	-	-	2
CE. 643	Environmental Engineering	-	-	-	2	-	1	2
Total		17	4	6	17	3	6	39

Number OF Hours / Week

First Term	Second Term
27	26

B-Refinery Engineering of Oil and Gas Branch

Subject Symbol	Subject	Hours / Week						Units
		First Term			Second Term			
		Theoretical	Practical	Tutorial	Theoretical	Practical	Tutorial	
CE. 133	Applied Mathematics	3	-	1	3	-	1	6
CE. 143	Mass Transfer	3	2	1	3	-	1	7
CE. 233	Statistics and Instruments	1	1	1	1	-	1	3
CE. 243	Reactor Design	3	-	1	3	-	1	6
CE. 343	Heat Transfer	3	-	1	3	2	1	7
CE. 443	Equipment Design by Computer	2	1	-	2	1	-	6
CE. 543	Storage and Transport of Crude and Petroleum Products	2	-	1	-	-	-	2
CE. 643	Combustion Engineering	-	-	-	2	-	1	2
Total		17	4	6	17	3	6	39

Number OF Hours / Week

First Term	Second Term
27	26

A-Unit Operation of Chemical Industry Branch

Subject Symbol	Subject	Hours / Week						Units
		First Term			Second Term			
		Theoretical	Practical	Tutorial	Theoretical	Practical	Tutorial	
CE. 144	Project	1	2	-	1	2	-	4
CE. 244	Transport Phenomena	3	3	1	3	-	1	7
CE. 344	Process Control	2	-	1	2	3	1	5
CE. 444	Chemical Industries	2	3	1	2	3	1	6
CE. 234	Optimization	-	-	-	2	1	-	3
CE. 644	Engineering of Catalyst	2	-	1	-	-	-	2
CE. 844	Corrosion Engineering	-	-	-	2	-	1	2
CE. 544	Technology of Oil and Gas	-	-	-	2	-	1	2
CE. 134	Management and Engineering Economics	-	-	-	2	-	1	2
CE. 744	Polymers Technology	2	-	1	-	-	-	2
Total		14	8	6	14	9	5	35

Number OF Hours / Week

First Term	Second Term
28	28

B- Refinery Engineering of Oil and Gas Branch

Subject Symbol	Subject	Hours / Week						Units
		First Term			Second Term			
		Theoretical	Practical	Tutorial	Theoretical	Practical	Tutorial	
CE. 144	Project	1	2	-	1	2	-	4
CE. 244	Transport Phenomena	3	3	1	3	-	1	7
CE. 344	Process Control	2	-	1	2	3	1	5
CE. 444	Petroleum Refining	2	3	1	2	3	1	6
CE. 544	Gas Technology	-	-	-	2	-	1	2
CE. 134	Management and Engineering Economics	-	-	-	2	-	1	2
CE. 234	Optimization	-	-	-	2	1	-	3
CE. 644	Catalyst Engineering	2	-	1	-	-	-	2
CE. 744	Petrochemical Industries	2	-	1	-	-	-	2
CE. 844	Environmental Pollution	2	-	1	-	-	-	2
Total		14	8	6	14	9	5	35

Number OF Hours / Week

First Term	Second Term
28	28

CE 111

English

Units 4

Theoretical 2 hr/week

Tutorial - hr/week

Practical - hr/week

First Semester**1- Comprehension**

Reading Scientific Passages

A- Solids, liquids and Gases

B- The Control of Electric Currents

C-Sir Isaac Newton

(18hrs)

2- Grammatical Points**A-The Sentence**

1- Affirmative

2- Interrogative

3- Negative

(4hrs)

B-Parts of Speech

1- Nouns

A-Function

B-Countability

C-non-Countability

(1hrs)

2-Pronouns:

Types and function

(1hrs)

3-Adjectives

A-Degree/Comparison

B- Order

(1hrs)

4-Verbs

A-Finite

B-Non- Finite

C-Transitive

D-Intransitive

(1hrs)

5-Adverbs

A-Classification

B-Formation

C-Order

(1hrs)

CE 111	<u>English</u>	Units	4
		Theoretical	2 hr/week
		Tutorial	- hr/week
		Practical	- hr/week

6-Prepositions:

A general idea

(1hrs)

7-Conjunctions

A-Main Conjunctions

B-Subsidiary

(1hrs)

8-Interjections:

Common ones

(1hrs)

Second Semester1- Comprehension

Reading Scientific Passages

1-Electricity in Early Days

2-Comets

3-Exploring the moon

(16hrs)

2- Grammatical Points

1-Articles

A-definite

B-indefinite

(2hrs)

2-The Sentence

A-Structure

B-Types

C-Main Parts:

1-Subject

2-Predicate

D-Expansion

(8hrs)

3-Written and Oral Translation

(4hrs)

CE 121

Mathematics

Units	6
Theoretical	3 hr/week
Tutorial	1 hr/week
Practical	- hr/week

1- Revision:

Equation of the straight line, Trigonometric functions and their sketches, Domain, Range, Inverse of functions, Absolute value, limits, Limits, applications, Polar coordinates (general definition) Conic sections (general definition).

(12 hrs)

2- Differentiation and Integration:

Algebraic functions and trigonometric functions, Application (limits, Hopitals rule)

(6 hrs)

3- Transcendental Functions:

Inverse of Trigonometric functions, Natural logarithmic Exponential and Power functions (Definitions, Properties, Sketches, Derivatives and Integrals.

(12 hrs)

4- Hyperbolic Functions:

Definitions, Properties, Sketches, inverse and Derivatives and Integrals.

(8 hrs)

5- Determinants:

Definitions, Properties, Solution of systems of equations (Cramers Rule)

(6 hrs)

6- Application of Definite Integrals:

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

(12 hrs)

7- Moods of integration:

Substitution, Integration by parts, The Substitution $U = \tan \frac{X}{2}$, 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, Improper Integrals (conv and dity)

(16 hrs)

8- Complex Numbers:

Definitions, Argands diagram, Addition and subtraction and multiplication and dividing numbers, Trigonometric and exponential formula of complex number, Demoivors theorem, Roots of equation, Power of complex numbers.

(9 hrs)

9- Vector Analysis:

Definition, Addition and subtraction of vectors, Multiplication by scalars, Direction, products of vector (scalar product and vector product).

(9 hrs)

CE 141

Principle of Chemical Engineering

Units	6
Theoretical	3 hr/week
Tutorial	1 hr/week
Practical	- hr/week

1- Concept of Chemical Engineering:

Units, Dimensions, Conversion factors, Conversion equation, Temperature, Pressure, Composition, Chemical Analysis, Chemical equations.

(24 hrs)

2- Material Balance Calculation:

Without and with chemical reaction, Recycle, By pass and purge calculations for steady state, Combustion Calculation.

(30 hrs)

3- Ideal Gas laws:

Definitions of Ideal gas, Real gas, Ideal gases mixture, Real gas mixture.

(9 hrs)

4- Energy Balance:

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

(18 hrs)

5- Simultaneous, Mass and Energy Balance:

(9 hrs)

CE 221	<u>Chemistry</u>	Units	8
		Theoretical	3 hr/week
		Tutorial	1 hr/week
		Practical	2 hr/week

Part -1- Analytical Chemistry

1- Introduction:

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

(4 hrs)

2- Solution:

Definition, Preparation and properties, Molarity, Normality, Formality, PH, POH, Solubility

(8 hrs)

3- Analytical Methods of Analysis:

a-Qualitative Analysis

b-Quantitative Analysis.

- i. Volumetric (titrimetric) & analysis,
Acid- base, Redox, Precipitation, Complex titration, Methods of calculation,
Titration curves
- ii. Gravimetric Analysis
Precipitation reactions, Direct and indirect methods of analysis, Ksp.
- iii. instrumental Methods of Analysis
Photometric,, Colourimetic, Potentiometric titration, , PH-measurements
Chromatography, Atomic absorption.

(33 hrs)

CE 221	<u>Chemistry</u>	Units 8 Theoretical 3 hr/week Tutorial 1 hr/week Practical 2 hr/week
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Part -2- Organic Chemistry

1- Introduction:

Definition and classification of organic compounds.

(3 hrs)

2- Aliphatic Compounds:

Nomenclature, Preparation, Properties, Reactions.

- a) Alkanes
- b) Alkenes
- c) Alkynes
- d) Aliphatic Derivatives: Alkyl halides Alcohol's, Ethers, Aldehydes, Ketones, Esters Carboxylic acids, Amines, Mercaptans, Carboxylic acids, Amines, Mercaptans, Thiophenes, Disulphide.

(20 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.

(10 hrs)

4- Heterocyclic Compounds:

Pyridine, Furan, Pyrrole.

(3 hrs)

5- Introduction to Polymer and Carbohydrate:

(5 hrs)

6- Organo-Metallic Compounds:

(4 hrs)

CE 131

Engineering Drawing

Units 4

Theoretical 1 hr/week

Tutorial - hr/week

Practical 2 hr/week

1- Introduction:

General information about engineering drawing and its importance, Drawing instruments, Types of lines used in drawings, Hidden lines.

(2 hrs)

2- Geometrical construction:

(2 hrs)

3- Pictorial Drawings:

(Isometric and Oblique)

(2 hrs)

4- Projection Drawings:

First and Third Angle Projection.

(4 hrs)

5- The Finding of 3 rd view:

(6 hrs)

6- Sectioning:

(6 hrs)

7- Fasteners:

(2 hrs)

8- Assembly and detail drawing:

(4 hrs)

CE 231

Mechanics and Strength of Materials

Units	4
Theoretical	2 hr/week
Tutorial	1 hr/week
Practical	- hr/week

A-Mechanics

- 1- Principles of static's:** (2 hrs)
- 2- Resultants of Force systems:** (5 hrs)
- 3- Equilibrium of force systems:** (5 hrs)
- 4- Friction:** (6 hrs)
- 5- Centurions and Centers of Gravity:** (5 hrs)
- 6- Moment of Inertia:** (4 hrs)
- 7- Principle of Movement:** (3 hrs)

B-Strength of Materials

- 1- Internal Forces in Rigid Bodies:** (1 hrs)
- 2- Definition of stress and strain:**
Types of stresses and strain, shear stress. (1 hrs)
- 3- Stress- Strain Diagrams:**
Stress- strain diagrams for ductile and brittle materials (2 hrs)
- 4- Proportional limits:**
Elastic limit, stiffness elasticity, plasticity, Toughness, Resilience, Hardness, Working stress. (2 hrs)

CE 231

Mechanics and Strength of Materials

Units 4

Theoretical 2 hr/week

Tutorial 1 hr/week

Practical - hr/week

<u>5- Hook law:</u>	(2 hrs)
<u>6- Poisson's ratio, Composite stresses:</u>	(4 hrs)
<u>7- Volumetric stress, Bulk modules:</u>	(4 hrs)
<u>8- Thin walled Cylinders:</u>	(4 hrs)
<u>9- Thermal stress:</u>	(4 hrs)
<u>10- shear and Moments in Beam:</u> Deflection	(4 hrs)
<u>11- Wind Effect on the Tower high Tower:</u>	(2 hrs)

CE 331

Electrical Technology

Units 2
Theoretical 1 hr/week
Tutorial 1 hr/week
Practical - hr/week

- 1- Semiconductors Equipment:** (3 hrs)
- 2- Rectifiers and Detectors:** (2 hrs)
- 3- Electronic Amplifiers:** (4 hrs)
- 4- D.C. Circuits:** (2 hrs)
- 5- D.C. Generators and Motors:** (3 hrs)
- 6- A.C Circuits:** (3 hrs)
- 7- Polyphases Circuits:** (2 hrs)
- 8- Transformers and Induction Motors:** (3 hrs)
- 9- Starters:** (2 hrs)
- 10- Integrated Circuits, Measuring Instruments, Tranducers, Transmitter:** (4 hrs)
- 11- Electrical Heating Appliance:** (2 hrs)

CE 321

Computer Science

Units	6
Theoretical	2 hr/week
Tutorial	- hr/week
Practical	2 hr/week

1- Introduction:

Component (hard ware), computer work, computer, composition, Application (2 hrs)

2- Files:

Definition, Types, Nomenclature, MSDos, External and internal commands. (4 hrs)

3- Introduction to window operating system:

Desktop, Mouse, my computer-icons, close window, stand by. (2 hrs)

4- Folders:

Size and cascade, windows folder construction, construction choose file or folder find file or folder copy file or folder. (2 hrs)

5- Start up:

Start up, Print, shutdown windows, format & Test Floppy disk, Arrange Icons, Run, Help. (2 hrs)

6- Word Program:

File commands (New, Open, Close, Save, Save as, Page setup, Edit, Undo typing, Repeat Typing, Cut, Copy, Paste, Clear, Select All, Find, Replace, Goto). (2 hrs)

7- Menu Table:

View (zoom, Header and footnote, Tool bar Insert (Picture, Footnote, Symbol, Page numbers, Textbox, Object).

Format (Paragraph, Font, Borders, Bullets & numbering Spelling and grammar

Table (shading, Columns, Insert, Table Insert Rows, Language, Delete, Cells, Split Cells, Select Row, Select column) (Table Autoformat Sort, Formula). (6 hrs)

8- Program Excel:

Open, Taskbar, Toolbar, Format, Sheet, Cell, Construction of sheet, Open file, Clear (Delete), Save (Save as), Close, cascade, Copy and Paste, Add, Delete, Find, Replace, Auto summation, Insert, equation, Format sheet, Auto format, Print, Print preview, Draw. (12 hrs)

CE 321

Computer Science

Units	6
Theoretical	2 hr/week
Tutorial	- hr/week
Practical	2 hr/week

9- Power Point:

Definition

FILE: New, Open, Open, Close, Save, Save as, Page set up, Print, Exit)

EDIT: Undo, Repeat, Cut, Copy, Paste, Select All, clear Duplicate, Delete slide, find, Replace

FORMAT: Font, Alignment, Text Direction slide, Layout, Background, Apply Slid Show, View show, Rehearse timing design set up show, present Animation, Animation Preview, Slide Transition).

(11 hrs)

10- Auto Cad:

Introduction, define screen draw, select point in the screen Limits, Status, Circle, Erase, Line, Color, Point, zoom, Redraw, Arc, Ellipse, Polygon, Donut, Solid, Fill Break, Copy, More, Pan, Mirror Trim, Extend, Charge, Line type Lt scale, Dis Area, Trace, Hatch text, Snap, Grid, Rotate, Cops, Ortho, Fillet, Dim Layer.

(14 hrs)

11- Internet:

(6 hrs)



CE 431

Workshop

Units 6

Theoretical - hr/week

Tutorial - hr/week

Practical 6 hr/week

Refer to Centralize Curriculum

CE 122	<u>English</u>	Units	4
		Theoretical	2 hr/week
		Tutorial	- hr/week
		Practical	- hr/week

First Semester

1- Comprehension

Reading Scientific Passages

1-Metals and Ores

2-Heat and its Effect

3- Mending Faces

(18hrs)

2- Grammatical Points

1-Verb Tenses (Simple and Continuous)

A-Present

B-Past

C-Future

(5hrs)

2-Active and Passive Voice

A-importance in scientific studies

B-the passive voice sentence

(5hrs)

3-Scientific Report writing

(3hrs)

Second Semester

1- Comprehension

Reading Scientific Passages

1-Electromagnetic

2-Light and Heat on the Moon

3-Time and the Stars

(16hrs)

CE 122

English

Units 4
Theoretical 2 hr/week
Tutorial - hr/week
Practical - hr/week

2- Grammatical Points

1-Verb Tenses (perfect and perfect Continuous)

A-Present

B-Past

C-Future

(5hrs)

2-Active and Passive Voice

A- Construction

B- fields of application

(5hrs)

3-Relative Clauses

(3hrs)

CE 122	<u>Mathematics</u>	Units	4
		Theoretical	2 hr/week
		Tutorial	1 hr/week
		Practical	- hr/week

1. Partial Differentiation:

Function of two or more variables, limits and continuity, partial derivatives, chain rule, Gradients, Directional derivatives, Higher order derivatives, Maxima, minimum and saddle points, Lagrange multipliers.

(10hrs)

2. Multiple integrals:

Double integrals, Area, Triple integrals in rectangular coordinates, Physical application of double and triple integration.

(9hrs)

3. Ordinary Differential Equations:

Solution of first order ordinary differential equations, Solution of second order ordinary differential equations, and higher order differential equation.

(9hrs)

4. Infinite Series:

Power series of functions, Taylor's theorem, Integration, Differentiation, Fouries series, Even and odd functions, Half range expansion, Periodic functions.

(8hrs)

5. Function and Definite Integrals:

The error function, The gamma function, The beta function, factorial function.

(6hrs)

6. Vector Analysis:

Products of three vectors, Equation of lines and planes.

(5hrs)

7. Complex Algebra:

Continuity, Derivation of Complex Variables, Analytic function, Integration of functions of complex variables and cauchy's theorem.

(5hrs)

8. Matrices:

The Matrix, Matrix algebra, The transpose of matrix, The inverse of matrix, Eigen Values and Eigen vectors, solution of linear equation by matrix.

(8hrs)

CE 142

Fluid Flow

Units 8
 Theoretical 3 hr/week
 Tutorial 1 hr/week
 Practical 2 hr/week

1. Introduction:

Physical properties of fluid, Definition of type fluid: Newtonian's, non-Newtonian, Incompressible, compressible fluid, static, Dynamic fluid, shear stresses in fluid.

(4hrs)

2. Dimensional- Analysis:

Rayleigh's method (Power series), Buckingham's Π -theorem.

(6hrs)

3. Fluid- Dynamic:

Fluid dynamic system, Boundary layer, Continuity equation, Momentum equation, Bernoulli's equation, Euler's equation, Application of Bernoulli's equation and continuity equation.

(10hrs)

4. Newtonian's Fluid-(Incompressible Fluid):

Laminar and Turbulent flow, Reynolds's number, Friction losses and Pressure drop in pipes and Fitting, Determine of pipe diameter, Flow in Branch pipes, Friction losses in non-circular pipes, velocity Distribution.

(10hrs)

5. Non- Newtonian Fluid:

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

(6hrs)

6. Compressible Fluid in pipes:

Pressure wave, Mach number, General equation, General equation for isothermal and adiabatic condition, work for isothermal and adiabatic of Compressor.

(10hrs)

7. Flow-Measurement:

Pilot-tube, Orifice meter, Venturi meter, Rotameters, Notch air Weirs, Special Flowerets (Hot wire anemometer, Gas meter).

(12hrs)

8. Pumping of Liquids:

Calculation of Total head, NPSH, Performance characteristics curve, Calculation of horsepower, equipment, and cost.

(8hrs)

9. Flow of Fluid Through Granular Beds:

Beds & Packed Column, Fixed beds, Fluidized Bed.

(8hrs)

CE 142

Fluid Flow

Units 8
Theoretical 3 hr/week
Tutorial 1 hr/week
Practical 2 hr/week

10. Mixing of liquids in Tanks:

Mixing, Mixers type, Small blade area, large blade area, Dimensionless groups, Power consumption.

(6hrs)

11. Two- Phase Flow and Pressure drop in pipes :

(4hrs)

12. Introduction in unsteady Flow:

(6hrs)

CE 132

Properties of Materials

Units	3
Theoretical	1 hr/week
Tutorial	1 hr/week
• Practical	2 hr/week

1. Engineering requirement for materials:

Mechanical Properties, stress-strain curve, elasticity, plasticity, ductility, young modulus, tensile stress, yield stress, bricking stress, true and engineering stress-strain diagram.

(4hrs)

2. Atoms and atomic coordination:

Ionic bond, inter-atomic distance attraction forces between atoms, coordination number, covalent bond, Metallic bond.

(4hrs)

3. Crystal structure:

Crystal structure, unit cell, types of unit cells simple cubic, Face centered cubic, body centered cubic, atomic packing factor, Previous lattice, Miller index, crystalline Planes, X-ray diffraction.

(4hrs)

4. Atomic disorder in solid:

impurities in solids, solid solutions in metals, Imperfection incrystals, point defect, line dislocation, surfaces + grain boundaries.

(4hrs)

5. Atomic movement in solid state:

Atomic diffusion, self-diffusion, diffusivity Fick's first law, diffusion constant, diffusivities versus temperature, Factors effect diffusivity.

(4hrs)

6. Phase diagrams:

Definition of alloys, binary alloys, phase diagrams (equilibrium thermal diagrams), eutectic; solid solution and combination type diagram, Iron-carbon face diagram, allotrope Trans formation (polymorphism).

(4hrs)

7. Corrosion:

Definition, why it happen, Type of corrosion, Form of corrosion, corrosion reactions (anode + cathode) corrosion rate measurement, methods of prevention.

(4hrs)

Note:

- 2nd term

CE 222	<u>Computer Programming</u>	Units	6
		Theoretical	2 hr/week
		Tutorial	- hr/week
		Practical	2 hr/week

1. **Introduction in visual Basic:** (2hr)
2. **Forms and Toll box controls:**
Forms and controls, setting a control's name. (2hr)
3. **Project Explorer:**
Project Explorer window, Properties, Events. (2hr)
4. **Project:**
Designing the visual Basic application (project) saving project, applications. (2hr)
5. **Files and projects:**
Files and projects, Examples, exercise. (2hr)
6. **Menus:**
Designing Menus, programming menu commands. (2hr)
7. **Boxes:**
Dialogue boxes, message dialogues Boxes, Font dialogue box, color dialogue box, print dialogue box. (2hr)
8. **General visual Basic statements:**
Data, numerical and string data, variables, Assignment statement, Syntax of declaration statement, declaration of constants, mathmetcd and logic operations, concatenation between strings, comment statement, using Immediate window. (6hr)
9. **Control flow statements:**
IF.... THEN statement, multiple IF....THEN statement, IF.... THEN.... EISE, Multiple IF.... THEN EISE, Select case statement, Switch function, IFF function, choose function. (10hr)
10. **FOR...NEXT Loop, Do WHILE.....Loop, Do.... Loop WHILE, Nested Loops.** (6hr)
11. **Array:**
Array definition, Declaring Arrays, using FOR....NEXT Loop with Arrays, Arrays and producers, operations on Arrays. (6hr)

CE 222	<u>Computer Programming</u>	Units 6
		Theoretical 2 hr/week
		Tutorial - hr/week
		Practical 2 hr/week

12. Strings:

Working with strings, strings management

(2hr)

13. Files:

Files, sequential files statements, User, Defined Type, Random files.

(10hr)

14. Database:

Working with database, Adding and Deleting records, displaying data.

(6hr)

CE 342

Fuels Technology

Units 3
 Theoretical 1 hr/week
 Tutorial 1 hr/week
 • Practical 2 hr/week

1. Energy and Fuel:

Energy and his classification in Technology section, Physical and chemical classification of fuel, solid Fuels (coal), the industrial processes on coal to Derived different Product.

(3hr)

2. Properties of oil stocks and prepare fractions oil:

Oil stocks, industrial processes which applied from the well to the different fractions in tower distillation and the processes on fraction.

(4hr)

3. Petroleum Fractions properties :

Benzene, Kerosene, Jet Fuel, Diesel, lubricants oil Asphalt, Fuel oil.

(9hr)

4. Gaseous Fuels and Liquefied gases:

Energy source types gases fuel types and liquefied gases which source of energy in industrial and houses.

(4hr)

5. Combustion Calculation:

Different type of equations about the subject and from it found the component which burner and the combustion equation and guess the flue gases and study behavior of combustion.

(6hr)

6. Burner of gases fuel:

The burner types of gases fuel and liquid fuel properties arrange it in Furnace.

(2hr)

7. Combustion in Furnaces:

Furnace types in oil industrial, Boilers and steam production that used in different industrial.

(2hr)

Note:

- 1st term

CE 242

Thermodynamics

Units	4
Theoretical	2 hr/week
Tutorial	1 hr/week
Practical	- hr/week

1. Introduction:

Fundamental quantities Time, Length, Mass, Force, Temperature.

(2hrs)

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.

(4hrs)

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

(8hrs)

4. Heat Effects:

Heat capacities of gases as a function of temperature, solids and liquids, Heat change accompanying phase change, Heat of industrial reactions.

(6hrs)

5. The Second Law of Thermodynamics:

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

(6hrs)

6. Thermodynamics Properties of Fluids:

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

(10hrs)

7. Refrigeration and Liquefaction:

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

(10hrs)

CE 222

Thermodynamics

Units	4
Theoretical	2 hr/week
Tutorial	1 hr/week
Practical	- hr/week

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 separation calculations.

(8hrs)

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 solution, effect of temperature on chemical equilibrium.

(6hrs)

CE 232

Physical Chemistry

Units 6
 Theoretical 2 hr/week
 Tutorial 1 hr/week
 Practical 2 hr/week

1. 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, Raoult's law for ideal mixtures, Non-ideal Liquid mixtures, The principle of distillation, Henry's law, solubility of gases in Liquids.

(10hrs)

2. 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.

(12hrs)

3. 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.

(16hrs)

4. Catalysis:

Reaction of catalyst in homogeneity system, Enzyme reactions and Kinetic of reactions

(6hrs)

5. Electrochemistry:

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

(6hrs)

6. Electrochemical Cells:

Electromotive force (EMF) of a cell, Measurements of EMF- the potentiometer, The polarity of electrodes, 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, Concentration cells, Electrolysis, Corrosion. Kinetic of reactions.

(8hrs)

CE 133

Applied Mathematics

Units	6
Theoretical	3 hr/week
Tutorial	1 hr/week
Practical	- hr/week

1. Revision ordinary differential equations:

First and second order, simultaneous differential equations, Application for chemical engineering.

(18hrs)

2. Solution of differential equations by series:

Simple series, method of Frobenius, Bessel's equation. Application for chemical engineering.

(18hrs)

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 function.

(18hrs)

4. Partial Differential Equations:

Formulating of partial differential equations. Solution of partial differential equations. Method of separating variables and Laplace transformation method.

(18hrs)

5. Numerical Analysis:

The difference operators. Interpolation. Finite difference equations. Solution of first and second order differential equations.

(18hrs)

CE 143

Mass Transfer

Units 7
 Theoretical 3 hr/week
 Tutorial 1 hr/week
 • Practical 2 hr/week

1. Introduction:

(4hrs)

2. Mass transfer fundamentals:

Steady state mass transfer. Diffusion in binary and multicomponent gases. Diffusion in binary and multicomponent solids. Convective mass transfer. Mass transfer coefficients. Two-film theory. Penetration theory. Unsteady state mass transfer methods

(25hrs)

3. Methods of gas-liquid separation (absorption and stripping):

Determination of interfacial mole fractions. Individual and overall mass transfer coefficients. Effect of gas solubility on equilibrium curve. Single stage absorption, multistage absorption. Finding number of stages graphically and through use of correlations for absorption and stripping. Packed columns limits of operation. Design of packed beds for dilute and concentrated solutions. Finding number of transfer units. Absorption with chemical reaction.

(16hrs)

4. Binary distillation:

Introduction, (T-x,y) and (x,y) equilibrium curves. Flash or equilibrium distillation for binary and multicomponent mixtures. Distillation with reflux using McCabe-Thiele. Sorel method to find number of stages. Fenske equation to find minimum reflux ratio and minimum theoretical stages. Column efficiency. Thermal method for finding number of ideal stages (Ponchon-Savarit Method). Multicomponent differential distillation.

(25hrs)

5. Multicomponent distillation:

Dew and bubble points calculation methods. Multicomponent equilibrium relationships. Minimum reflux and minimum number of stages. Short-cut method. Checking validity of reflux ratio used. Operating limits of distillation columns.

(14hrs)

6. Mechanical separation process and size reduction:

Classification of equipment. Particle shape factor. Power requirements in crushers. Particle size analysis.

(6hrs)

Note:

- 1st term

CE 233	<u>Statistics and Instrument Measurements</u>	Units	3
		Theoretical	1 hr/week
		Tutorial	1 hr/week
		Practical	1 hr/week

Part A: Statistics

1. Introduction:

Qualitative and conclusive statistics, population samples, graphical representation of data.

(2hrs)

2. Table and graphical representation:

Primary data, repeatability, normal distribution.

(2hrs)

3. Media determination:

(2hrs)

4. Scatter determination:

Standard and relative deviations.

(2hrs)

5. Standard distributions:

(4hrs)

6. Chi distribution:

Confidence limits, Chi test, degree of freedom.

(2hrs)

7. Curve fitting:

Least square method, linear relations, exponential equations, gradient, and correlation coefficient.

(2hrs)

Part B: Measurements

1. Measurements:

Absolute and relative. Environmental conditions. Application on physical properties.

(2hrs)

2. Errors:

Types of errors, determination of errors.

(4hrs)

3. Instruments:

For temperature, Pressure, level, composition, velocity, flow rate.

(8hrs)

CE 243

Reactor Design

Units	6
Theoretical	3 hr/week
Tutorial	1 hr/week
Practical	- hr/week

1. Introduction:

Stoichiometry, reaction rate constant, order of reaction, reversible and non-reversible reactions, conversion, yield, selectivity.

(9hrs)

2. Types of reactors:

Batch reactors, continuous flow reactors i.e. CSTR, PFR. Industrial reactors.

(9hrs)

3. Batch reactors:

Design equation, reaction time, maximum production rate, non-isothermal operation, adiabatic operation

(18hrs)

4. Tubular reactors:

Design equation, isothermal and non-isothermal operation, residence time, length of reactor, number of tubes, pressure drop, space velocity.

(18hrs)

5. Continuous stirred tank reactions:

Design equation for isothermal operation, scale-up of liquid-phase batch data to the design of CSTR. CSTR's in parallel and in series.

(15hrs)

6. Unsteady state operation of reactors:

Start up of CSTR, semi-batch reactor.

(9hrs)

7. Multiple reactions:

Operation in parallel and in series for single and multiple reactions to obtain maximum amount of desired product.

(6hrs)

8. Comparison between reactors:

Comparison between batch, tubular, and CSTR for single and multiple reactions

(6hrs)

CE 343

Heat Transfer

Units 7
 Theoretical 3 hr/week
 Tutorial 1 hr/week
 • Practical 2 hr/week

1. Modes of heat transfer:

Material properties of importance in heat transfer.

(2hrs)

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-convection systems, fins.

(24hrs)

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.

(18hrs)

4. Heat exchangers:

Various types and their general characteristics. Fouling factor. Heat exchanger mean temperature differences. Co-current and counter-current flow.

(12hrs)

5. Shell and Tube Exchangers:

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

(6hrs)

6. Condensation and Boiling Heat Transfer:

Condensation of single vapors. Design calculations for condenser, condenser-subcooler and superheated condenser.

(9hrs)

7. Radiation and furnace design:

Radiation properties, shape factor, heat exchange for non black bodies, parallel planes, shields, gas radiation, boiler.

(9hrs)

8. Unsteady state heat transfer:

Temperature as a function of time, lumped capacity system, quenching of small bodies, heating of tank reactor.

(10hrs)

Note:

- $\frac{nd}{2}$ term

CE 443

Equipment Design using Computers

Units	6
Theoretical	2 hr/week
Tutorial	- hr/week
Practical	1 hr/week

Part (A)**1. Process Planning:**

Scheduling and flow sheet design. Flow sheet types and designation. Block diagram. Process flow sheet. Piping and instruments diagram. Utility flow sheet. Equipment layout and plot plan. Project evaluation. Feasibility studies. Site selection. Project cost estimation.

(6hrs)

2. Piping networks and pumps:

Pipe fittings, valves. Steam traps. Piping design standards. Piping material and selection. Pump specifications and data sheets. Optimum diameter. Types of pumps. Hydraulic characteristics for centrifugal pumps.

(6hrs)

3. Vessels and Tanks:

Types of vessels. Flash drums. LPG tanks. Criteria in vessel design. Stress considerations. Design of tall vertical vessel. Design of pressure vessels. Supports and foundations

(6hrs)

4. Heat transfer equipment:

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

(6hrs)

5. Mass Transfer Equipment:

Types of columns. Plate and packed Types of plates and packing. Design features. Pressure drops in columns.

(6hrs)

CE 443	<u>Equipment Design using Computers</u>	Units	6
		Theoretical	2 hr/week
		Tutorial	- hr/week
		Practical	1 hr/week

Part (B) : Complete equipment design of each of the following units:

1. Pressure vessels, pumps and compressors:

Flash drum. Gas-liquid separator, LPG storage tanks. Cyclone separators. Gas movers and compressors. Pumps. Piping network. etc.

(8hrs)

2. Heat Equipment:

Shell and tube heat exchangers. Plate heat exchanger. Boilers. Furnaces. Vaporizers. Air coolers. Coil type heaters. Condensers. etc.

(10hrs)

3. Mass transfer equipment and reactors:

Distillation column. Absorber. Extractor. Dryer. Absorption towers. Leaching equipment. Scrubbers. Stripping towers. Reactors.

(12hrs)

CE 543

Biochemical Engineering

Unit Operations Branch

Units	2
Theoretical	2 hr/week
Tutorial	1 hr/week
Practical	- hr/week

1. **Definition, introduction:** (2hrs)
2. **Industrial micro organisms and methods of separation:** (2hrs)
3. **Micro organisms genetics:** (4hrs)
4. **Biotechnological methods of growths:**
Liquid systems, batch and continuous cultures. Breaded cultures Solid
Fermentation's (6hrs)
5. **Single cells proteins:**
Microorganisms used, treatment of waste, production of single cell protein. Diet
value (3hrs)
6. **Bakery yeast:**
Dry and ready effective types. (3hrs)
7. **Amino acids:**
Clotamic acid. (1hr)
8. **Organic acids:**
Acetic acid. (1hr)
9. **Enzymes:** (1hr)
10. **Antibiotics:**
Microorganisms producing antibiotics, Penicillin (1hr)
11. **Industrial Alcohol:**
Alcoholic fermentation, microorganism used, production method. (1hr)
12. **Animal cell cultivation:** (2hrs)
13. **Plant cell Cultivation:** (1hr)
14. **Environmental cleaning using biotechnology:**
In the fields of water treatment. Organic Pollutants. Petroleum wastes. (2hrs)

CE 643

Environmental Engineering

Units 2
Theoretical 2 hr/week
Tutorial 1 hr/week
Practical - hr/week

Unit Operations Branch

1. Introduction:

What is pollution and a historical brief on international concern with pollution. Types of pollutants and measurements. Pollution allowable limits in the environment. (2hrs)

2. Cleaning of air and industrial gases:

Sources and effects of air pollution. Methods of control. Designing pollution equipment. Settling chamber, Cyclone separator, Venture scrubber, spray tower, cyclone scrubber, packed bed, electrostatic precipitator. Economic evaluation of gas cleaning. (10hrs)

3. Water and heavy water treatment:

Physical methods of treatment. Occupation methods. River water cleaning, heavy water treatment. Desalination. (10hrs)

4. Industrial and sewage treatment:

Industrial water treatment. Sewage water treatment. (4hrs)

5. Solid pollutants:

Sources and effects. Methods of control of solid pollutants. (4hrs)

CE 543	<u>Storage and Transport of Crude and Petroleum Products</u>	Units	2
		Theoretical	2 hr/week
		Tutorial	1 hr/week
	<i>Refinery Engineering Branch</i>	Practical	- hr/week

1. Fluid Flow:

Petroleum liquids flow. Petroleum gases flow. Designing pipe network from optimum velocity and diameter viewpoint. Crude and petroleum products pipelines, Heating and pumping stations, Increasing pumping rates by looping. Increasing pumping rates by polymer additives. Two-phase flow. Unsteady state flow and hammering.

(14hrs)

2. Pressure Vessels / Tanks:

Stress systems of shells. Bending and membrane shells. Equilibrium equation for a shell element and LPG tanks, Rotationally symmetrically loaded membrane shell. Crude oil huge tanks.

(8hrs)

3. Selection of Materials for Vessels and Pipelines:

Selection of materials for vessels to limit corrosion. Selection of materials for pipelines to limit corrosion. Cathodic protection.

(8hrs)

CE 643

Combustion Engineering*Refinery Engineering Branch*

Units	2
Theoretical	2 hr/week
Tutorial	1 hr/week
Practical	- hr/week

1. **Combustion reaction stoichiometry:** (8hrs)
2. **Excess air and flame temperature:**
3. **Combustion products:**
4. **Gas, solid, and liquid fuels:**
5. **Flammability limits:** (8hrs)
6. **Flame and combustion speed:**
7. **Flame stability:**
8. **Gas, liquid and solid fuels burners:** (6hrs)
9. **Combustion zones and temperature profiles:**
10. **Radiation and convection rooms in furnaces:**
11. **Furnaces and the tubular furnace:**
12. **Chimney height calculation:** (8hrs)
13. **Furnace efficiency and heat loss calculations :**
14. **Furnace wall layers and refractories:**
15. **Tube layers in furnaces:**

CE 144	<u>Project</u>	Units 4
		Theoretical 1 hr/week
		Tutorial - hr/week
		Practical 2 hr/week

1. Introduction:

Literature, Methods of manufacturing, Capacity of the Process Physical and Chemical Properties

2. Material and Energy Balances:

Review of Material and Energy balances, Flow sheet Symbols, PFD Information in Flow Diagram

3. Choice of Process Devices and Equipments:

Pumps, Valves, Pipes, Measuring Devices and Controllers, Material of Construction, PID Plot

4. Choice of Plant Location and Layout Standards:

5. Industrial Services:

Cooling Tower, Boilers, Study Problems from Industrial Waste Disposals, and How to Prevent the Environment, pollution.

6. Use a Computer Program to Design:

Introducing a Complete Project with Material and Energy Balances Design of Devices, Calculation of Costs, Choice of Location

CE 244

Transport Phenomena

Units 7
 Theoretical 3 hr/week
 Tutorial 1 hr/week
 • Practical 3 hr/week

1. Boundary Layer and analogies:

Boundary Layer in Laminar and turbulent Flow, Boundary Layer in Laminar sub Layer, Transition layer, Velocity distribution on Surfaces and Pipes, Momentum, heat and mass transfer molecular diffusion, Eddy transfer, Reynolds analogy, Modified Reynolds analogy, Chilton and Colburn analogy.

(20 hrs)

2. Evaporation:

Introduction, Types of Evaporations, Evaporation Equipment, Heat transfer in Evaporation Process, single, double and Multi effect Evaporators, Design of evaporators, Comparison of Forward, backward and Parallel effect evaporators, boiling Point rise.

(12 hrs)

3. Drying:

Introduction and general Principle in drying, Rate of drying, the mechanism of moisture movement, Calculation of rate of drying, moisture transport in Solids at Constant and falling rate Period, Capillary movement, Material and Energy Balances in Continuous dryers, Types of Dryers

(8 hrs)

4. Humidification, dehumidification and Cooling towers:

Humidification, dehumidification, Temperature humidity Chart for air – water system . Enthalpy – humidity –temperature chart. Addition of Vapor or liquid Stream to a gas Stream. Mechanism of dehumidification Evaluation of heat and Mass transfer Coefficient, Cooling tower, height of Packing in Cooling towers, Minimum gas Condition, Change of Condition of liquid and gas in Cooling towers.

(14 hrs)

5. Extraction:

Definition, Extraction process, Equilateral Triangular coordinates (Ternary Diagram), system of three liquid _ one pair partially soluble, system of three liquid _ two, pairs partially soluble, choice of solvent, Equipment in extraction cross _ current extraction, multi stage Cross Current extracting cross current for insoluble Liquid , Continuous Counter current extraction , Continuous Counter Current in Soluble , Liquid , Minimum Solvent , Counter Current extraction with reflux .

(22 hrs)

Note:

- 1st term

CE 244	<u>Transport Phenomena</u>	Units 7
		Theoretical 3 hr/week
		Tutorial 1 hr/week
		Practical 3 hr/week

6. Filtration:

Type of Filters, Filtration theory, Plate and frame filter press, leaf filter, filtration at Constant ΔP , Filtration at Constant rate, washing Time.

(10 hrs)

7. Crystallization:

Introduction Equilibrium Solubility in crystallization, Classification of Crystallizes, Nucleation theory, Rate of Crystal Growth, Material and Energy balance in Crystallization.

(4 hrs)

CE 344

Process Control

Units 5
 Theoretical 2 hr/week
 Tutorial 1 hr/week
 • Practical 3 hr/week

1. Revision of Laplace Transformation:

(4 hrs)

2. Process Dynamic and Transient Response of the system:

Dynamic and Control For chemical Process, Dynamic behavior for 1st order system, linearization, Interacting and non-interacting, Second order system, Transportation.

(16 hrs)

3. Characteristics of the closed loop System:

Over all closed loop transfer functions and block diagram algebra Transient of Simple Closed loops System, Stability of Control, Introduction to the Frequency analysis and design technique.

(20 hrs)

4. Industrial Controller:

Actions selection Criteria for Various Control modes, final Control element, Dynamics and Control of Chemical reactor System.

(10 hrs)

5. Dynamic and Control of some Complex Chemical Process:

Heat exchanger, distillation Column, Introduction to Computer Control of Chemical Process.

(10 hrs)

Note:

- 2nd term

CE 444	<u>Chemical Industries</u>	Units	6
		Theoretical	2 hr/week
		Tutorial	1 hr/week
	<u>Unit Operation Branch</u>	Practical	3 hr/week

1. Chemical Processing:

Introduction, Operating Conditions, Type of Process. (3 hrs)

2. Sulphur and Sulphuric acid:

Raw materials, Frasch Process, Lead Chamber Process, Contact Process, Oleum Production. (4 hrs)

3. Ammonia and Nitric acid:

Raw materials, Production Steps, Production Process. (6 hrs)

4. Nitrogenous Fertilizers:

Ammonium Sulphate, Ammonium nitrate, Urea. (4 hrs)

5. Phosphoric acid:

Wet Process Phosphoric acid, Electric Furnace (4 hrs)

6. Phosphate Fertilizers:

Superphosphate, Triple Superphosphate. (4 hrs)

7. Electrolytic Industries:

Principle and theory, Caustic Soda Production Chlorine Production (4 hrs)

8. Industrial Salts:

Sodash Production (3 hrs)

9. Ceramic Industries:

Raw materials, Chemical Conversions, Porcelain, Fire Clay (4 hrs)

10. Cement Industries:

Raw materials, Portland Cement (4 hrs)

11. Glass Industries:

Raw materials, Manufacture of Glass (4 hrs)

CE 444	<u>Chemical Industries</u>	Units	6
		Theoretical	2 hr/week
		Tutorial	1 hr/week
		Practical	3 hr/week
<i>Unit Operation Branch</i>			

12. Surface Coating Industries:

Paint, varnishes, lacquers

(4 hrs)

13. Oils and Fats:

Fatty acids, Manufacture of Vegetable Oils and Waxes

(4 hrs)

14. Soap and Detergents:

Soap Production, Detergents Production

(4 hrs)

15. Sugar Industries:

Cane Sugar, Beet Sugar

(4 hrs)

CE 234	<u>Optimization</u>	Units 3
		Theoretical 2 hr/week
		Tutorial 1 hr/week
		Practical - hr/week

1. Introduction to Optimization Methods:

(4 hrs)

2. Organization of Optimization problems:

(4 hrs)

3. Single Variable:

Analytical methods, numerical methods, graphical methods, numerical Search, restriction Function, unrestricted Function, Direct search, Dichotomous Search, golden Search, Fibonacci Search

(12 hrs)

4. Multivariables Optimization Methods:

- Necessary Conditions For Extreme Values in graphical Cases.
- Solution by graphical method.
- Simplex method.
- Linear Programming and application in Chemical engineering (transportation mixing)

(10 hrs)

CE 644	<u>Engineering of Catalysts</u>	Units 2
		Theoretical 2 hr/week
		Tutorial 1 hr/week
		Practical - hr/week

Part One

1. Catalysts:

Definitions, Properties of Catalysts

(2 hrs)

2. Steps in a Catalytic Reaction:

Adsorption, Surface Reaction, Desorption, Rate Equations for each Step.

(4 hrs)

3. Finding Rate Law and Mechanism:

Equations of Rate Limiting Step.

(4 hrs)

4. Design of Reactor for Gas – Solid Reactions:

Basic Guidelines. Design Equations.

(8 hrs)

5. Heterogeneous Data Analysis for Reactor Design:

Deducing a Rate law from the Experimental Data, Finding a Mechanism Consistent with Experimental Observations, Evaluation of the Rate law Parameters, Reactor Design

CE 644

Engineering of Catalysts

Units 2
Theoretical 2 hr/week
Tutorial 1 hr/week
Practical - hr/week

Part Two

1. Introduction:

Properties of Catalysts, Determination of Surface Area, Void Volume and Solid Density, Pore Volume Distribution, Classification of Catalysts, Promoters and Inhibitors, Catalyst Poisoning.

(4 hrs)

2. Rate Equations of Fluid-Solid Catalytic Reactions:

Rate of Adsorption, Desorption and Surface Reaction, Rate of the limiting Step, Mechanism, Design of Reactor for- Gas- Solid Reactions. Data Analysis for Reactor Design

(10 hrs)

3. External Transport Processes in Heterogeneous Reactions:

Equations of Mass –and Heat Transfer, Calculations of the Concentrations on the Surface, Calculations of Temperature Differences in External Transport Processes, Fluidized Bed Reactors, slurry Reactors

(4 hrs)

4. Internal Transport Processes:

Gaseous Diffusion in Single Cylindrical Pores, Surface Diffusion, Effectiveness Factor, Thiele – Type Modulus

(4 hrs)

5. Design of Heterogeneous Catalytic Reactors:

Fixed – Bed Reactors, Fluidized Bed Reactor, Slurry Reactions

(8 hrs)

CE 844	<u>Corrosion Engineering</u>	Units 2
	<i>Unit Operations Branch</i>	Theoretical 2 hr/week
		Tutorial 1 hr/week
		Practical - hr/week

1. **Introduction:**
Definition of Corrosion, why it happens, direct and indirect disadvantages. (2 hrs)
2. **Types of Corrosion:**
Dry Corrosion, wet Corrosion, Eight form of Corrosion (4 hrs)
3. **Mechanism of Crevice Corrosion:** (2 hrs)
4. **Electrochemical cell:**
Electrode Potential, types of reference electrodes. (4 hrs)
5. **Corrosion rate Calculation:**
Wet loss method, electrochemical method (2 hrs)
6. **Polarization:**
Definition, Types. (4 hrs)
7. **Passivity:** (2 hrs)
8. **Effect of Temperature and velocity on corrosion reaction:** (2 hrs)
9. **Method of Protection:** (4 hrs)
10. **Instruments to measure Corrosion rate:** (4 hrs)

CE 134	<u>Management and Engineering Economic</u>	Units 2
		Theoretical 2 hr/week
		Tutorial 1 hr/week
		Practical - hr/week

1. Principles of Management and its application in industry:

Types and duties (such as Production, marketing, Personal management, Financial duties etc)

(5 hrs)

2. Feasibility Study of industrial site:

This will include industrial Site and Factors affecting Choice of the site.

(5 hrs)

3. Production and Productivity:

Types of production, optimum Design, Production Lines, Plant Layout, Machine Balance.

(5 hrs)

4. Maintenance and its types:

Costs of maintenance machine Replacement.

(5 hrs)

5. Critical Path Method (CPM):

Types and applications

(5 hrs)

6. Quality Control in industry:

Quality Control in industry and its applications in Production lines .ISO and its application in industry.

(5 hrs)

CE 744	<u>Polymer Technology</u>	Units	2
		Theoretical	2 hr/week
		Tutorial	1 hr/week
<u>Unit Operations Branch</u>		Practical	- hr/week

1. Polymers:

Nomenclature

(2 hrs)

2. Polymers Classification:

Classification based on Sources, Classification based on Chemical nature of Polymers, Technical Classification of Polymers

(2 hrs)

3. Polymerization:

Step growth, Polymerization (condensation polymerization) Free radical Polymerization, Ionic (cationic, Anionic) Coordination Polymerization (Steroregular Polymerization) Polymerization by group transfer

(6 hrs)

4. Polymerization Systems:

Bulk, Solution, Suspension, Precipitation

(4 hrs)

5. Molecular Weight of Polymers:

Methods of measurement of molecular weight of Polymers

(2 hrs)

6. Polymer composites:

(2 hrs)

7. Polymer blends:

(2 hrs)

8. Physical Properties of Polymers:

(4 hrs)

9. Mechanical Properties of Polymers:

Tensile strength, Impact strength, Creep, hardness

(4 hrs)

10. Polymer Processing:

Molding, Extrusion, Thermal Forming Calendaring

(4 hrs)

CE 444	<u>Petroleum Refining</u>	Units	6
		Theoretical	2 hr/week
		Tutorial	1 hr/week
	<i>Refinery Engineering Branch</i>	Practical	3 hr/week

1. **Introduction:**
History and Development of Refining Processes Kinds of Refineries. (2 hrs)
2. **Chemical Composition of Petroleum:** (2 hrs)
3. **Physical and Thermodynamic Properties of Petroleum oil:** (2 hrs)
4. **Evaluation of oil stocks:** (4 hrs)
5. **Introduction to Processing:**
Stabilization, dehydration, tube still heaters (10 hrs)
6. **Fractionation of Petroleum:**
Atmospheric and Vacuum Fractionation (2 hrs)
7. **Fractionation Towers:**
Material and Energy Balances, Reflux Temperature Distribution in Fractionation Tower, Tower Diameter (8 hrs)
8. **Treating Processes:**
Removal of Acid Gases, Sweetening Processes, improvement in Performance and storage stability. (8 hrs)
9. **Upgrading processes:**
Thermal Cracking, Cooking, Visbreaking, Catalytic, Cracking, Hydrocracking, Catalytic Reforming, Alkylation, Isomerisation. (10 hrs)
10. **Product Blending:**
Blending of vapor pressure, octane number, viscosity, flash point aniline point, and pour point. (6 hrs)
11. **Manufacturing of lubricating oils:** (4 hrs)
12. **Treating process using Hydrogen:** (2 hrs)

CE 544

Gas Technology

Units 2
 Theoretical 2 hr/week
 Tutorial 1 hr/week
 Practical - hr/week

Refinery Engineering Branch

1. **Classification of Gaseous fuels thermodynamic:** (3 hrs)
2. **Physical and Chemical Properties for natural Gas:** (3 hrs)
3. **Drying of Gaseous Fuels:**
 Drying by Adsorption, Drying by Absorption (4 hrs)
4. **Sweetening of Gaseous Fuels:**
 Sweetening by Adsorption, Sweetening by Absorption (6 hrs)
5. **Gas Processing units:**
 Flash Separation Processes, Distillation of multicomponent gas mixture (6 hrs)
6. **Liquefied Petroleum Gases:** (2 hrs)
7. **Production of Hydrogen:** (2 hrs)
8. **Sulfur recovery processes from Acid gases streams:** (4 hrs)

CE 744	<u>Petrochemical Industries</u>	Units	2
		Theoretical	2 hr/week
		Tutorial	1 hr/week
		Practical	- hr/week
<u>Refinery Engineering Branch</u>			

1. Introduction:

Chemical Process Industries

(1 hrs)

2. Basic Petrochemical Materials:

Low Olefins, Steam Cracking Processes Cooling, Purification Processes Cooling Processes, Purification Processes Compression, Separation Operations, Energy System, Diolefins, Sources of diolefins, Butadiene Separation, Isobutylene Production, Conversion Process For Production of diolefins, Higher Olefins Production methods of higher olefins, linear, Alkyl benzene Complex, Aromatics, Basic materials Aromatic Sources, Separation of benzene – Toluene – Xylene, Syntheses Gas, Steam reforming, Partial Oxidation

(10 hrs)

3. Synthetic Zeolites:

(2 hrs)

4. Intermediate Petrochemicals:

Methanol, Ethylene Oxide Acetic Acid, Ethanolamine, Vinylchloride, Ethyleneglycol Acrylonitrile, Adipic Acid, Methyl Tetrabutyl ether, EthylbenZene, Styrene, Phenol, Nitrobenzene, Ethylene, Cyclohexane, Benzoic acid, Terephthalic acid.

(7 hrs)

5. Petrochemical Detergents:

(2 hrs)

6. Polymers:

LDPE, HDPE, PP, PVC

(4 hrs)

7. Synthetic Fibers:

(2 hrs)

8. Petrochemical Complexes:

(2 hrs)

CE 844	<u>Environmental - Pollution</u>	Units	2
		Theoretical	2 hr/week
	<u>Refinery Engineering Branch</u>	Tutorial	1 hr/week
		Practical	- hr/week

1. Introduction:

Definition of Pollution, literature surveys on international interest of Environmental Pollution Problems. Pollutants, Type of Pollutants, Measuring Devices, Allowable level of Pollutants in Environment.

(2 hrs)

2. Air Pollution:

Air Pollutants, Particulate matter, SO₂, CO, NO, ...etc Sources and effect, Control Treatment Methods, Design of some Equipment: Centrifugal, Cyclone, Scrubber, Packed Bed Ventura, Spray – tower, Electrostatic Separator, and Chimney Design.

(12 hrs)

3. Water – Pollution:

Water Pollutants, Sources and effect, Organic and non – organic, Radiation activity, Suspended Solids and Sculling Salts, Control Treatment of Water Pollution for: Drinking, Industry Processes, Desalination methods, Reverse Osmosis, Electrodialysis, Solar Distillation, Primary, secondary and advanced treatment of Wastewater, Treatment of oily Pollution.

(12 hrs)

4. Pollution of Solid – Waste:

Sources, Effects, Control Treatment method of Removal Solid – Waste, Treatment by economy methods.

(6 hrs)

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