Nirma University of Science and Technology
Institute of Diploma Studies
Course Structure for First Year of Diploma in Chemical Engineering
(2004-05 Onwards)

Semester-I

Sr. No.	Course Code	Course Name	Teaching Scheme				Examination Scheme					
			Hours / Week			Credit	Hours		Examination Weightage			
			L	T	P		MSE	SEE	Lect MSE	Lect SEE	TA	LPW
1.	1HMF01	English	2	2	2	5	1.5	3	0.20	0.40	0.15	0.25
2.	1MAF03	Mathematics-I	4	1	-	5	1.5	3	0.25	0.60	0.15	-
3.	1SCF05	Science-I	4	-	2	5	1.5	3	0.20	0.40	0.15	0.25
4.	1MEH01	Elements of Engineering Graphics	3	-	4	5	2	4	0.20	0.40	0.15	0.25
5.	1MEH02	Shop Skills	-	-	2	1	-	-	-	-	-	1.00
6.	1IAF05	Internet Application	-	-	2	1	-	-	-	-	-	1.00
		Total:	**13**	**3**	**12**	**22**						

Semester-II

Sr. No.	Course Code	Course Name	Teaching Scheme				Examination Scheme					
			Hours / Week			Credit	Hours		Examination Weightage			
			L	T	P		MSE	SEE	Lect MSE	Lect SEE	TA	LPW
1.	1HMF02	Communication Skills	2	2	-	4	1.5	3	0.25	0.60	0.15	-
2.	1MAF04	Mathematics-II	4	1	-	5	1.5	3	0.25	0.60	0.15	-
3.	1SCF06	Science-II	4	-	2	5	1.5	3	0.20	0.40	0.15	0.25
4.	1CLH03	Applied Mechanics	3	1	1	4	1.5	3	0.20	0.40	0.15	0.25
5.	1CEH05	Computer Application	-	-	4	2	-	-	-	-	-	1.00
6.	1CFF06	Computer Fundamentals	2	1	2	4	1.5	3	0.20	0.40	0.15	0.25
		Total:	**15**	**5**	**9**	**24**						

L – Lecture, T - Tutorial, P – Laboratory/Project work (LPW), TA – Term Assignments, MSE – Mid Semester Examination, SEE – Semester End Examination.

FIRST YEAR OF DIPLOMA PROGRAMME

1HMF01 ENGLISH

L	T	P	C
2	2	2	5

1. ***Short Stories***
   Introduction. Reading (aloud/silent, individually/group). Giving the plot/gist of the story (summarizing skills) – oral and written. Framing and Answering questions – oral and written.
   Vocabulary exercises: Identifying new words, word attack skills- finding meanings, word and idea generation skills, using the words in sentences.
2. **Grammar**
   Determiners, Auxiliary verbs, Tenses, Subject – verb agreement
3. **Letter – writing**
   Personal letters – letters to friends and relatives
   Social Letters – Application for leave, letter of apology, thanks giving and letters of invitation
4. **Prose Units**
   Introduction. Reading (individually/group, aloud/silent). Answering / framing questions (orally and in writing). Summarizing the passage, highlighting the main points.
   Vocabulary exercises: Identifying new words, finding meanings, word and idea generation skills, using the words in sentences.
5. **Paragraph writing**
   Describing a machine, incident, situation, a person, a phenomenon (scientific), a process (technical) or an event
6. **Grammar**
   The passive, Infinitives, Prepositions, Clauses and connectors, Modifiers

Tutorials: It will consist of minimum of ten tutorial assignments based on above topics.

1MAF03 MATHEMATICS – I

L	T	P	C
4	1	-	5

1. **Trigonometry**
   Measurement of angles – Degree and radian, Area of sector and arc length, Trigonometric functions – Addition formulae and allied angles, Factor formulae – Formulae for multiple and sub multiple angles, Inverse trigonometric functions, Properties of a triangle – Solution of a triangle
2. **Co-ordinate Geometry**
   Point
   Distance formula for R^2, Centroid of a triangle, Division of a line segment
   Straight Line
   Equation of a straight line in R^2, Slope of a straight line, Intercepts on axes, Equation of a straight line passing through two points (x_1, y_1) and (x_2, y_2), Equation of a straight line having slope m and passing through the point (x_1, y_1), Equation of a straight line having an intercept on y-axis and slope m, Parallel and perpendicular straight lines, relation between their slopes, Angle between two straight lines, perpendicular distance from a fixed point of a line

   Circle

   Equation of a circle having its centre at (h,k) and radius r, General equation of a circle
   General equation and rough sketch of parabola, hyperbola, ellipse

ALGEBRA

3. **Reorientation of indices and logarithm**
4. **Surds**
   Definition & concept, Simple examples on surds, Square root of surds, Examples on square root of surds
5. **Determinants**
   Definition of determinants, Order of determinants, expansion of determinants of order 2 and 3, solution of equations by determinants (Cramer's Rule)

6. **Arithmetic and geometric progression**
   Sequence and series, Arithmetic progression – definition, formulae for n^{th} term of an A.P., sum of n terms of an A.P., Definition of arithmetic mean, Examples, Geometric progression – definition, formulae for nth term of a G.P., sum of n terms of a G.P., Definition of geometric mean, Examples
7. **Binomial Theorem**
   Definition of ${}^{n}P_{r}$ and ${}^{n}C_{r}$, Statement of Binomial theorem, General term and middle term for positive integral index, Application of Binomial theorem for approximate values
8. **Introduction to a Matrix**
   Definition of a matrix, Different types of matrices, Addition and subtraction of matrices, Multiplication of matrix by a scalar, Multiplication of two matrices, Transpose of a matrix, Adjoint of a matrix, Inverse matrix of order 3, Solution of two linear simultaneous equations in R^2, Solution of three linear simultaneous equations in R^3

Tutorials: It will consist of minimum of ten tutorial assignments based on above topics.

1SCF05 SCIENCE – I

L	T	P	C
4	-	2	5

1. **Units and Dimensions**
   Introduction, Fundamentals and derived units, Dimensions of physical quantities
2. **Gravitation**
   Gravitation, Newton's law of gravitation , Definition and derivation of unit of 'G'., Acceleration due to gravity, Satellite, Escape Velocity, Critical Velocity, Communication Satellite.
3. **Gas laws and specific heat of gases**
   Boyle's, Charle's and Gay-Lussac's laws, Absolute zero temperature and Kelvin scale, General gas equation PV=nRT, Specific heat of gases. Cp & Cv and relation between Cp & Cv, Thermal conductivity, coeffieicnt of thermal conductivity and temperature gradients.
4. **Surface tension and viscosity**
   Surface tension and its molecular theory, Determination of surface tension using capiliary tube and its application, Viscosity and Newton's law for viscous force. Coefficient of Viscosity, Poiseuille's and Stoke's methods to determine viscosity. Application of viscosity.
5. **Sound waves, acoustic of buildings and ultrasonic**
   Sound wave – wavelength – frequency - speed relation - transverse and longitudinal waves, Echo and reverberation of sound. Sabine's formula, Acoustical planning of auditorium, Ultrasonics – Piezo – electric method. Application of ultrasonics.
6. **Modern Physics**
   LASER – Principle and its production, Application of LASER, Nature of X-rays, their production, Properties and application of X-rays, Photoelectric effect.
7. **Atomic Structure**

Modern Atom – Composition of Atom, Distribution of electrons in shells – Energy levels and sub-energy levels, Atomic orbitals, Aufbau principle, Electronic configuration of atoms, Electronic configuration of inert gas elements, Electronic theory of valency - Types of valency, Formation of electrovalent and covalent compounds

8. **Fundamental of basic chemistry**
   Chemical formula and molecular weight – Equivalent weight, Mole concept, Concentration of solutions, Types of chemical equation – Calculation on basis of chemical equation
9. **Ionisation**
   Atoms & ions, Ionisation – Factors affecting the ionisation, Degree of ionization, Ionic equilibrium in water – Concept of pH and its importance in engineering field, Electrolysis and their applications
10. **Basic concepts of organic compounds**
    Introduction to organic compounds – Difference between inorganic and organic compounds, Characteristic of organic compounds, Classification of organic compounds, Utility of various organic compounds in human life

Practical / Term - work - Practical / term-work will consist of minimum ten experiments / exercises based on above topics.

1MEH01 ELEMENTS OF ENGINEERING GRAPHICS

L	T	P	C
3	-	4	5

1. **Introduction To Engineering Drawing:**
   Use of engineering drawing as a language of engineers, size and layout of drawing sheets, boards, scales, different types of lines, lettering, rules and regulations of drawing general principles of projection, sections and other conventions of drawing, general principles of dimensioning, methods of dimensioning, symbolic representation as per B.I.S. SP 46 Use of drawing instruments.
2. **Loci of Points:**
   Loci of point moving with given constrain such as keeping its distance equal from (fixed circle and fixed line), (fixed point and fixed line), fixed two circles and line, fixed three circles, Loci of point on mechanism such as slider crank mechanism, Four bar chain mechanism, crank and connecting rod mechanism with C.R. constrained to pass through guide, trunion.
3. **Engineering Curves:**
   Conics Curves:
   (i) Ellipse – different methods to construct ellipse such as directrix, Arcs of circles, Concentric circles, oblong and parallelogram Method (ii) Parabola – different methods to construct parabola such as directrix, rectangle, parallelogram and tangent method (iii) Hyperbola – Rectangular and oblong hyperbola, different methods to construct hyperbola such as directrix and asymptotes.
   Eccentricity of conic Sections, normal and tangent to the curves, CYCLOIDAL CURVES: Cycloid, Epicycloid and Hypocycloid, Normal and Tangent to Cycloidal curves, INVOLUTE – Involute of regular polygon & circle. Normal and tangent to the involute, SPIRAL – Archemedian spiral, Logarithmic spiral, Helix: Helix on cylinder only.
4. **Introduction to Screw thread:**
   Introduction of various portion of a screw thread such as pitch, root diameter, nominal diameter, effective diameter, lead, slope, flank, angle, root, crest, external, and internal threads, single start and multi start threads, right hand and left hand threads; Conventional representation of external and internal threads.
5. **Introduction to Orthographic Projection:**
   Introduction of projection, Reference planes (H.P. VP and PP) of projection; projectors, reference line, different views of orthographic projection such as F.V., T.V., S.V. First and third angle projection system, symbols for systems of projection;

6. **Sectional Orthographic Projection:**
   Sectional views - Full, half, partial, broken, revolved, removed and offset sectional views, sectioning conventions, section lines, cutting plane line, dimensioning of views as per B.I.S.
7. **Isometric Projection:**
   Isometric projection, Isometric axes, Isometric lines and planes, Non-isometric lines and planes, Isometric scale, Isometric projection by box method, Co-ordinate method and offset method. Iso Metric Projection of sphere and arcs. Dimensioning; Isometric view.

Practical / Term - work - Practical / term-work will consist of minimum six experiments / exercises based on above topics.

1MEH02 SHOP SKILLS

L	T	P	C
-	-	2	1

1. Appraisal of common workshop processes such as Carpentry, fitting, smithy, plumbing.
   - Identification of hand tools used in various shops, specifications and materials of hand tools.
   - Correct method of handling and using tools.
   - Correct method of use and selection of measuring instruments.

Practical / Term - work - Practical / term-work will consist of minimum four experiments / exercises based on above topics.

1IAF05 INTERNET APPLICATION

L	T	P	C
-	-	2	1

1. **What is Internet and How it works**
   Introduction of networks, Types of connections: LAN, MAN, WAN, dial-up, leased, History of Internet, Usage of Internet, Server and Client (Browser)
2. **Connection to the internet**
   Introduction to ISP and URL, Web Browsers - Use of Browsers, Type of browsers, Using a Browser
3. **Surfing the web**
   Web pages, Website, Home Page, Hyper links, Different sites-educational, portal, entertainment, News, Jobs, Banking, Maps, Yellow pages, Forums, Discussion groups and interest groups, joining and leaving groups, Accessing courseware on the Web
4. **Electronic Mail**
   Overview of email, Creating mail account / Group account, Access email, Sending email, File attachment / Transfer, Mail box management, Maintaining address book
5. **Searching on web**
   Search engine, Types of search engine, Searching information & Search Techniques
6. **Downloading & Uploading**
   What is downloading / Uploading? Downloading files, Uploading files

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1HMF02 COMMUNICATION SKILLS

L	T	P	C
2	2	-	4

1. **Introduction to Communication Skills**
   What is Communication?, Importance of communication, Barriers in communication – communication gap & communication break down, Types of communication – verbal & non-verbal
2. **Oral Communication – Listening Skills**

Listening

Types of listening – acoustic, linguistic, attitudinal, Barriers in listening, Understanding and comprehending the message – decoding messages

3. **Oral Communication – Speaking Skills**

Conversational situations – face to face & telephonic

:roducing yourself and others, Thanking a person, Describing a person, place, thing, situation & event, Giving instructions, Making inquiries – at a bank, post- office, air- port etc., Asking questions, Making requests

Pronunciation, Voice – speed, tone and volume

4. **Vocabulary building**

Reference skills – dictionary, thesaurus

Building word- power

Spelling, meaning and usage of words, Antonyms, synonyms, homophones & homonyms, Prefixes

and suffixes

Words with silent letters, Words commonly misspelt, Words commonly confused, Idiomatic usage – phrasal verbs, cultural expressions

5. **Reading Skills**

Scanning – focused reading to collect specific information, Skimming – reading a text to get the general idea, Reading & Comprehending articles and reports on technical subjects, Interpretative reading

6. **Written Communication – Writing Skills**

Composition writing-free composition & guided composition, Resumes- job applications, Business letters

Complaint letters, Request letters, Placing orders, Asking for and giving information

7. **Non-Verbal Communication Skills**

Postures, Gestures, Facial Expressions, Eye-contact, Space-distancing, Aesthetics of communication, Clothing.

Teaching Methodology

(1) Drill Exercises
(2) Audio – Video laboratory
(3) Role- Playing – dramatization of situation
(4) Various individual and group exercises – self learning/pair learning/group learning
(5) Word puzzles and games

Tutorials: It will consist of minimum of ten tutorial assignments based on above topics.

1MAF04 MATHEMATICS – II

L	T	P	C
4	1	-	5

1. **Functions**

Definition of function, Different types of functions, examples

2. **Limit**

Definition of limit, Meaning of $\lim_{x \to 0} f(x)$, Working rules of limit (without proof), Evaluation of limit of simple algebraic functions and trigonometric limits

3. **Differentiation**

Definition, Derivative by first principles**,** Formulae of derivatives of standard functions and inverse trigonometric functions – Formulae of derivatives of sum, product and quotient of functions, Chain rule (Only statement), Derivative of parametric and implicit functions – Simple problems based on it, Second order differentiation: Evaluation of second order derivatives of simple functions
Application of derivatives – Velocity, Acceleration, Maxima and Minima their examples

4. **Integration**
   Definition of Indefinite Integrals – Formulae of integrals of some standards functions, Working rules of indefinite integrals (without proof), Evaluation of simple indefinite integrals, Integration by substitution**,** Definite integrals – Fundamental principle of definite integrals (only statement), Working rules of definite integrals (without proof), Evaluation of simple definite integrals using the fundamental principle**,** Application of integration – Area, Volume (Only straight line, circle, Parabola, hyperbola and ellipse are to be considered)
5. **Vector Algebra**
   Vector and scalar quantities – Definition of the terms**,** Types of vectors – Geometrical Representation of vectors**,** Addition and subtraction of vectors – Units vectors i , j & k, Use of unit vectors, Position vectors in terms of i , j & k – Magnitude and direction of vectors and it examples, Product of vector and a scalar – Dot & cross product of two vectors, Applications –Work done by force and moment of force and their examples

Tutorials: It will consist of minimum of ten tutorial assignments based on above topics.

1SCF06 SCIENCE – II

L	T	P	C
4	-	2	5

1. **Water**
   Introduction – Hard and Soft water, Degree of Hardness of water – Disadvantages of hard water, Methods of softening hard water, Requirements of drinking water, Purification of water for domestic purposes
2. **Corrosion**
   Introduction – Magnitude of corrosion problem, Types of corrosion – Immersed corrosion, Electrode potential – Mechanism of electrochemical corrosion, Factors affecting the rate of corrosion, Protection of metals from corrosion – Methods of applying metal coating
3. **Non-metallic materials**
   Paints, varnishes and enamels, Insulators, Lubricants, Refractories, Adhesives, Glasses and ceramics
4. **Static Electricity**
   Electric charge, Coulomb's inverse square law, unit charge, electric field, field intensity, electric lines of forces, Electric flux, flux density, Gauss theorem, electric potential, potential due to a charged sphere, Capacity – unit, capacitance, principle of condenser, condenser in series and parallel.
5. **Current Electricity & Electromagnetism**
   Ohm's law, resistance, specific resistance, resistances in series and parallel. Theory of shunt, Wheatstone's network, Wheatstone's bridge, potentiometer, effect of temperature on resistance, platinum resistance thermometer, effect of temperature variations on resistivity of conductors and insulators.
   Heating effect of electric current, Joule's Law, electric power and electric energy, calculation of electric bills, Seeback effect, measurement of high temperatures by bimetallic thermocouple.
6.
   Electromagnetism
   Magnetic effect of electric current, magnetic induction, Laplace's law, Biot-Savart's Law.Construction and working of Ammeter, Voltmeter & Moving coil galvanometer.
   Electromagnetic induction, Faraday's Law, Lenz's law, emf generated in a coil due to rotation in uniform magnetic field, AC and DC generator principle and working.

7. **Elementary Electronics**

Introduction to elementary electronics, Energy bands in conductor, semiconductor & insulator, Temperature effect on semiconductor

n-type & p-type semiconductor, properties of p-n junction diode and its V-I characteristics, Applications of diode, Zener diode, difference between conventional p-n junction diode & zener diode. Applications of zener diode.

Practical / Term - work - Practical / term-work will consist of minimum ten experiments / exercises based on above topics.

1CLH03 APPLIED MECHANICS

L	T	P	C
3	1	1	4

1.

Fundamentals

Fundamental units, Derived units, System of units, Scalar and vector quantities, Introduction to applied mechanics.

2.

Forces And Resolution of Forces

ɔncept of particle and rigid body: Force, its characteristics and effects, system of forces., principle of transmissibility. Resolution of force: into two mutually perpendicular component, into two non – perpendicular components

3.

Composition of Coplanar Forces

Composition of forces by using: Parallelogram law of forces, Triangle law of forces, Polygon law of forces, Method of Resolution.

Moment of force, Couple and its characteristics, Varignon's theorem and its applications, Solution of simple problems on above topics

4.

Equilibrium

Equilibrium of system of forces and equilibrant, Conditions of equilibrium, Type of supports and reactions at support. Space, free body and force diagrams and their use, Lami's theorem and its applications, Equilibrant for simple system of coplanar forces.

Beams: Type of beams, point load and uniformly distributed loads, Simple, Roller and Hinge support, and reactions at supports.

Solution of simple problems based on above topics.

5.

Friction

Limiting friction, angle of repose, coefficient of friction, laws of static friction, Simple problem based on horizontal plane and inclined plane.

6.

Centre of Gravity

Centroid of linear and plane element, C.G. of solid, Solution of simple problems based on regular and composite shapes made up of regular shapes.

7.

Simple Lifting Machine

Definitions: Effort, load, Mechanical advantage, velocity ratio, input, output, efficiency, ideal machine,

reversibility and condition for reversibility of machine, law of machine.
Solution of simple problems based on simple lifting machine like:
Pulley block system (single sheave, two sheave and three sheave block system), Simple axle and wheel, Differential axle and wheel, Simple screw jack, Single purchase crab, Double purchase crab, Weston's Differential Pulley block.

8.

Rectilinear Motion

Basic concepts and definitions: Motion, Rectilinear motion, displacement, distance, velocity, speed, acceleration, uniform velocity, average velocity, instantaneous velocity, uniform acceleration.
Equations of rectilinear motion with uniform acceleration, distance traveled by a particle in n^{th} second, velocity time diagrams, equation of motion under gravity, distance traveled by freely falling body during n^{th} second after it is dropped, velocity of a freely falling body when it just touches the ground. Solution of simple problems based on above topics.

9. Motion of Rotation (Angular Motion)

Definitions: Angular displacement, angular velocity, angular acceleration, uniform angular velocity and angular acceleration. Equations of circular motion with constant angular acceleration, relation between rectilinear motion and circular motion, angular distance moved by a body in n^{th} second. Centripetal and Centrifugal force. Solution of simple problems based on above topics.

10.

Kinetics

Definitions: Mass, momentum, impulse, impulsive force, impact, Newton's laws of motion, law of conservation of momentum. Recoil of gun, motion of lift. Solution of simple problems based on above topics.

11.

Work, Power and Energy

Definitions: Work, graphical method of representation of work, Power, Mechanical energy (Potential and Kinetic energy), Work-Energy principle, law of conservation of energy. Solution of simple problems based on above topics.

Tutorials: At least 70 problems covering above syllabus have to be solved.

1CEH05 COMPUTER APPLICATION

L	T	P	C
-	-	4	2

1. Brief Overview of Win-95:

Desktop, Task Bar, Start Menu, Icons, Screen Saver, Window Appearance, Explorer, Paint Brush, Calculator

2. Overview of Microsoft Word:

Introduction, Creating documents, Editing documents, Tools - Spell Check

3. Formatting In MS-Word:

Fonts, Different Views of Documents, Ruler, Margins, Alignments, Different types of Tabs. Bullets and Numbering, Newspaper Columns, Page Break, Adding Graphics, Adding Borders to the Page

4. Working with Tables In MS-Word:

Creating tables, Modifying tables, Enhancing Tables, Converting text to table and vice-versa

5. Mail Merge and Printing Features in MS-Word:

Mail Merge-Definition, Data source, Form Letter
Headers and Footers, Page Number, Print Preview and Printing a document

6. Overview of Microsoft Excel:

Introduction, Worksheets, Workbook, Cell, What is Label, Value and formula? Formula Bar and Formulas, Working with Ranges, Working with Worksheets, Types of Cell Addresses, Page Break Preview

7. **Advnace Formatting in Excel:**
   Different types of Formats like Accounting, Currency, Fraction etc.,
   Creating Custom Formats, Auto Formats, Working with Styles
8. **Functions in Excel:**
   What are Functions? Difference between functions and formulas, Different types of functions like sum, average, min, max etc., Paste Function AutoSum, Auto Calculate
9. **Charts and Macros in Excel:**
   Definition of Chart, Different types of charts, Charting Terminology, Chart Wizard, Customizing Chart, Previewing and Printing Charts Definition of Macro, Macros - Creating and Recording, Editing, Running and Deleting
10. **Overview of Microsoft PowerPoint:**
    Introduction, Different ways of creating presentations, Templates, Different views of Presentations,
11. **Formatting Presentations in Microsoft PowerPoint:**
    Design Templates, Autolayouts, Slide Master, Color Schemes, Backgrounds, Animations, Slide Miniature, Slide Transitions, Meeting Minder, Annotating Slides, Kiosk presentation
12. **Graphics in Microsoft PowerPoint:**
    Creating a Graph, Modifying a Graph, Organization Chart, Drawing Tools

Practical / Term - work - Practical / term-work will consist of minimum ten experiments / exercises based on above topics.

1CFF06 COMPUTER FUNDAMENTALS

L	T	P	C
2	1	2	4

1. **General Applications of Computer:**
   Introduction of Computer, Hardware, Software, Operating System, Computer Networking, Computers use in industry, Office Automation.
2. **Problem Solving and Flowchart:**
   Problem Solving, Flow Charting, Branching, Looping,
3. **Basics of BASIC:**
   Importance of BASIC, Programme analysis, Listing & Editing of BASIC Programme, Running the Programme, System Commands, Common BASIC Statements.
4. **Constants of Variable:**
   The character set, Constants, Variables, Naming the Variables, getting data into the memory and the RESTORE statement.
5. **Expression in BASIC:**
   Arithmetic expressions, Hierarchy of operations, Rules of Arithmetic, Evaluation of Expression - LET statement, Refinement in programming, Logical expressions and Library Functions.
6. **Printer Controls:**
   Comma Control, Semicolon Control, TAB Function and PRINT USING control.
7. **Jumping, Branching and Looping:**
   Jumping - GO TO statement, Branching - IF. …. THEN statement, Multiple branching - ON… GO TO statement and looping - FOR….. NEXT statement.
8. **Subscribed Variables:**
   Single - Subscripted variables, Double subscripted variables and searching and sorting.
9. **Functions and Subroutines:**
   User - Defined functions, Subroutines, Multiple - Parameter functions, Multiple - line functions and named subroutines with arguments.

Practical / Term - work - Practical / term-work will consist of minimum twelve exercises / programmes based on above topics.

Nirma University of Science and Technology
Institute of Diploma Studies
Course Structure for Second Year of Diploma in Chemical Engineering

Semester –III

Sr. No.	Course Code	Course Name	Teaching Scheme				Examination Scheme					
			Hours / Week			Credit	Hours		Examination Weightage			
			L	T	P		MSE	SEE	MSE	SEE	TA	LPW
1.	1CLH04	Essential of Environmental Science	3	-	-	3	1.5	3	0.25	0.60	0.15	0
2.	1CCS01	Entrepreneurship Development	3	-	-	3	1.5	3	0.25	0.60	0.15	0
3.	1EEB01	Electrical Machine & Electronics Instruments	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
4.	1CHB02	Inorganic & Physical Chemistry	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
5.	1CHB07	Fluid Flow Operation	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
		Total:	**15**	**0**	**6**	**18**						

Semester - IV

Sr. No.	Course Code	Course Name	Teaching Scheme				Examination Scheme					
			Hours / Week			Credit	Hours		Examination Weightage			
			L	T	P		MSE	SEE	MSE	SEE	TA	LPW
1.	1CHB03	Organic Chemistry	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
2.	1CHB04	Chemical Process Technology – I	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
3.	1CHB06	Industrial Stoichiometry	3	-	-	3	1.5	3	0.25	0.60	0.15	0
4.	1CHB09	Heat Transfer	3	1	2	5	1.5	3	0.20	0.40	0.15	0.25
5.	1CHA01	Mass Transfer – I	3	1	2	5	1.5	3	0.20	0.40	0.15	0.25
		Total:	**15**	**2**	**8**	**21**						

L– Lecture, T– Tutorial, P – Laboratory/Project Work (LPW), TA – Term Assignments, MSE – Mid Semester Examination, SEE – Semester End Examination

SECOND YEAR OF DIPLOMA CHEMICAL ENGINEERING

SEMESTER III

1CLH04 ESSENTIALS OF ENVIRONMENTAL SCIENCE

L	T	P	C
3	0	0	3

1. Introduction

Concept of Environment - Definition & Components, Brief idea about Environment Science, Environment Engineering and Environment Management

Divisions of Environment - Atmosphere, Hydrosphere, Lithosphere & Biosphere

Importance of Environmental awareness - Public awareness & Role of NGO

2. Ecological aspects of Environment

Brief idea about ecology

Ecosystem - Brief introduction, components, food chain, Eltonian pyramid and Energy flow

Biogeochemical cycles - Hydrologic, Nitrogen, Carbon, Phosphorous and Sulfur cycles

Brief idea about Biodiversity and ecological prospectus of human

3. Natural Resources

Brief introduction about natural resources

Water resources - Principal forms, Sources and Demand, Causes due to mis management and remedial

Forests - Exposure on forest area, necessity, Deforestation, Afforrestation, Forest conservation

Wild life - Introduction, necessity and wild life conservation

Land - Brief exposure on types of land, Use and abuses of land, Brief idea about soil erosion, desertification, salinization, water logging, Waste land: types & management

Population V/s Resources

4. Global Environment problems

Acid rain - Introduction, Causes and Remedial measures

Green House effect - Introduction, Causes and Remedial measures

Ozone layer depletion - Introduction, Causes and Remedial measures

Measures against global problems (warnings)

5.

Environmental Pollution

Brief idea about pollutant, pollution and its types

Water pollution - Significance of water, quality of water, Sources of water pollution, Common water impurities and typical harmful effects, Standard for drinking water, Brief exposure about water and domestic waste water treatment plant

Air pollution - Definition, classification of air pollutants, Sources and its effects of pollutant, Brief exposure on air monitoring, Brief description about air pollution control devices and Preventive measures

Noise pollution - Acoustics, levels of Noise, standards, sources, uses, effects and control measures

Radio active pollution - Sources, uses, effects and control measures

Brief idea about thermal, Soil and Visual pollution

6. Clean technology

Introduction : Clean and Clean up technology, Principles of Clean technology for waste minimization, Reuse and recycling of end products/waste water, Classification and brief description of energy, Fertilizers - Types and Causes, Brief idea about Bio fertilizers, Pesticides - Classification and brief description, Precautions for its usage and causes

7. Environment Legislation

Need of Environment Legislation, Brief exposure on various acts on "Prevention & control of pollution" e.g., The water act 1974, The water cess act 1977, The air act 1981, The environment act 1986, Motor Vehicles act 1988, Brief introduction to Pollution Control Policy

8. **Environment Impact Assessment**
   Necessity, Checklist & brief guidelines for EI A, Measurement of Environmental Impact, Brief idea about Environment Management Plan, Brief idea about Environment Monitoring

Text / Reference Books

- A textbook on Environmental pollution & control - Dr. H. S. Bhatia
- Environmental Engineering and Management - Suresh K. Dhameja
- Environmental pollution control engineering – C. S. Rao
- Water supply & sanitary Engg. (Env. Engg.) – Rangwala
- Essential of Environment (337) - Course Learning Manual prepared by CEC, Directorate of Technical Education, Gujarat

1CCS01 ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

1. **Entrepreneur, Entrepreneurship and Enterprisevital link for economic development.**
   Understanding the concept of Entrepreneur, Entrepreneurship and importance of small enterprises for the economic development of the country. Who can be an Entrepreneur? Why Entrepreneurship? What are the qualities and traits of successful Entrepreneur? Self-assessment.
2. **Entrepreneurship as a career choice**
   Why should we encourage Entrepreneurship? Importance of being Entrepreneurial. Benefits to individual, organisation and society.
3. **Resource mobilization form 'Support System'**
   Whom to contact for what?, Assistance and incentives available from Central/state Government, [IC/DIC], Small industry Development Bank [SIDBI], State Finance Corporations [SFCs] and various other agencies.
4. **Achievement Motivation Training. (AMT)**
   Developing Entrepreneurial Personality. Achievement motivation Training [AMT] and Developing Entrepreneurial Competencies. Specialized inputs of twelve hours based on Behavioral science exclusively designed for developing Entrepreneurial attitude among the students.
5. **Business Opportunity Identification and Selection [BOI]**
   How to identify and select a Business Opportunity? What are the processes and techniques? How to use brain storming technique? Methods of Environment scanning and data collection. Understanding BOI process. Products profile preparation and product selection.
6. **Market Survey tools and techniques**
   What are Market Survey? How to carry out Market survey? What are tools and techniques? How to prepare questionnaire? How to undertake field survey? How to write market survey report? Assignment of preparing market survey report.
7. **Preliminary Project Report [PPR]**
   What is PPR? Why PPR? How to prepare PPR? Assignment for preparing PPR.

NOTE: Following thing are required to be included at a specific time during the course study.

1. Visit to small-scale units: - Minimum five to seven different types of units must be shown to students. Profile of these units to be kept ready prior to visit. Students will have to work in small groups to complete the assignments based on these visits. A presentation by a group leader to be followed on the next day of the visit.
2. Details of existing SSI units in and around Ahmedabad and its data to be maintained at the department.
3. Special guest lectures of successful entrepreneurs to be organised as and when possible for better interaction with the students.
4. More inputs on establishing SSI unit and preparation of detail project report to be included during last semester.
5. More inputs on Management of SSI and strategies for growth to be included in the last semester.

Text / Reference Book

- A hand book for New Entrepreneurs by EDI, Ahmedabad

1EEB01 ELECTRICAL MACHINES & ELECTRONICS INSTRUMENTS

L	T	P	C
3	0	2	4

1. **Introduction**

   Magnetic circuits – (simple treatment) – Define and express the terms pertaining to magnetic circuits, Flux, flux density, permeability, reluctance, field intensity, magnetising force, Cork screw rule, Fleming's L. H. rule

2. **A. C. Fundamentals**

   Generations of alternating voltage and current – Wave form & expression of instantaneous value of above quantities, Define the following terms pertaining to A.C. – Amplitude, Cycle, Frequency, Time period

   Phase & phase difference – Define and explain phase & phase difference with the help of wave forms, Explain "Lead" & "Lag" w. r. t. A. C. quantities.

   RMS & Average value – Define RMS & average value, Solve simple problems

   A.C. through R, L & C – Circuit diagram, Vector diagram and final expression for – A.C. through pure resistance, A.C. through pure inductance, A.C. through pure capacitance

   A.C. series circuit – Series circuit – Circuit diagram, Vector diagram, Expression for voltage, current, impedance, power & power factor, Solve simple problems

3. **D. C. Machines**

   D. C. Motors – Parts of D.C. machine and their functions, Types of D.C. motors – Connection diagram, Applications

   D.C. motor Starter – Necessity of starter, Connection diagram of 3-point starter

   Speed control of D.C. motor – Field control, Armature control

4. **A. C. Machines**

   Transformers – Working principle and types of transformers, Various parts of power transformer and their functions

   Induction motors – Types of 3-phase induction motor – Construction, Applications, Comparison, List of different types of starters for IM., Speed control of Induction Motor (simple treatment) – Thyristor drives control, Connection diagram & applications of different types of 1-ϕ induction motor

5. **Measuring Instruments**

   Classification of instruments – Classification of instruments – Symbols, connection diagram of indicating instruments, ammeter, voltmeter, wattmeter

   Multimeters – Application of analog and digital multimeter

   Introduction of C.R.O. – Front panel control diagram and functions of each control, Measurement of voltage and frequency using C.R.O.

6. **Electronic Devices**

   Discrete components, Symbols, Connection diagram, Applications of BJT, SCR, TRIAC, DIAC, Photo diode, Photo transistor, Photo voltaic cell, LED, Transistor as amplifier, Construction operation, Characteristic and application of SCR, Introduction to OPAMP, Explain working, principle and applications of H.F. Heating.

7. **Digital Circuits**

   Logic Gates & Universal Gates, Testing of Gates of various IC's Like 7400, 7404 etc.

8. **Control System**

   Explain with illustration types of control systems – Open loop c.s., Closed loop c.s.

   Connection diagram, working & application of various control components like control valve, AC & DC techogenerators, stepper motor.

   Types of controller – On Off, Proportional (P), Integral (I) and Derivative (D) and application of each of these to step input.

9. **Instrumentation**

   Block diagram of instrumentation system, Transducers – Classification of transducer, Explain one application of each transducer with sketch, Measurement of physical quantities using transducer with simple diagram like, temperature, pressure, flow, level, thickness, speed, strain, PH value

10. **Microprocessor Application**
Block diagram of 8085. Function of each block, Measurement and control of temperature of a furnace using microprocessor

Practical / Term - work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Books

- Electrical Technology Vol. – I & II by B. L. Theraja
- Electrical Measuring Instruments and instrumentation by A. K. Shawaney - Dhanpatrai and sons
- Applied Electronics - Markande Rao
- Digital Principles - Malvino
- Instrumentation devices and system by Rangam, Mani & Sharma - THM
- Industrial Instrumentation by S. K. Singh

1CHB02 INORGANIC & PHYSICAL CHEMISTRY

L	T	P	C
3	0	2	4

1. **Periodic table and periodic properties**
The long form of periodic table – Periodic properties of elements, Types of elements, Electron affinity, Electronegativity
2. **Chemical bond**
Introduction, Co-valent bond – Bond capacity of C, H, N, O, Cl, S & Si, Bond Polarity, Valence bond theory, Molecular orbital theory, Hybridization – sp, sp^2 and sp^3, Hydrogen bond – Vander wall's forces of attraction, Metallic bond
3. **Solutions and Colloidals**
Solute, solvent and solution – Types of solutions, Nature & Properties of solute and solvent, Methods of expressing concentration of solution, Colligative properties of solution, Vapor pressure and Rault's Law, Lowering of Vapor pressure, Elevation of boiling point, Freezing point depression, Osmosis and laws of osmotic pressure, Introduction to colloidals and their types
4. **Phase Rule**
Homogeneous and Heterogeneous systems, The Phase rule – Phases, components, degree of freedom, One component system – Water system, Sulphur system
5. **Ionic Equilibria**
Introduction – Sparingly soluble salts, Acid and bases – Hydrolysis & Hydrolysis constant, Buffer solutions, Exact treatment of acid base ionic equilibria, Acid-base titrations
6. **Chemical Thermodynamics**
Introduction – Systems, states and state functions, Work and heat – First law of thermodynamics, Thermochemistry – Criteria for spontaneous processes, Entropy – Molecular interpretation of spectroscopy, Third law of thermodynamics – Free energy – Free energy and equilibrium constants, Temperature dependence of equilibria
7. **Chemical Kinetics**
Introduction – Classification of reactions, Reaction mechanism , Reaction rates and equilibria, Concentration effects , Temperature effect, Rates of reactions in solutions

Practical / Term-work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Books

- V. D. Bhatt, S. S. Shah, Dr. K. D. Patel & Dr. B. C. Dixit ; "Inorganic Chemistry & Physical Chemistry" , Atul Prakashan
- P. L. Soni & O. P. Dharma; "Physical Chemistry", published by S. Chand & Sons
- P. L. Soni ; "Inorganic Chemistry" ,published by S. Chand & Sons

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1CHB07 FLUID FLOW OPERATION

L	T	P	C
3	0	2	4

1 Dimensional Analysis

Units & Dimensions, Dimensional Analysis

2 Fluid Statics and its Applications

Introduction to fluid mechanics - Fluid statics and dynamics, Nature of Fluids, Pressure Concept, Equation of Hydrostatic Equilibrium – Compressible fluids, Incompressible fluids, Manometers – Simple U – Tube manometer, Inclined manometer, Two fluid manometer, Well type manometer, Continuous gravity Decanter – Centrifugal Decanter (Description only)

3 Fluid – Flow Phenomena

The Velocity Field, One-dimensional flow, Laminar and Turbulent flow, Velocity gradient and rate of shear for laminar flow, Viscosity – Viscosity and momentum flux, Kinematic viscosity, Newtonian and Non-Newtonian fluids (Time-dependent flow and Time independent flow), Boundary layer and Boundary layer formation in straight tubes, Boundary layer separation and Wake formation.

4 Basic Equations of Fluid Flow

Continuity equation, Average velocity – Mass velocity, Bernoulli Equation and Correction factors in Bernoulli Equation – Kinetic energy correction factor**,** Correction for fluid friction, Pump work in Bernoulli Equation, Hagen – Poiseuilles Equation (No derivation)

5 Friction in Flowing Fluid

Effect of Roughness, The Friction factor chart, Hydraulic radius and equivalent diameter, Friction from changes in velocity or direction – Friction loss from sudden expansion of cross section, Friction loss from sudden contraction of cross section, Friction loss in fittings and valves

6 Transportation of Fluids

Pipe, fittings and valves – Selection of pipe size, Joints and fittings, Prevention of leakage around moving parts – Stuffing boxes, Mechanical seals, Valves (Description and uses) – Gate valves, Globe valves, Plug cocks valves, Ball valves, Check valves

7 Fluid moving Machinery

Introduction to Fluid moving machinery, Pumps – Developed head and power requirement, Suction lift and Cavitation, Positive – Displacement Pumps (Description and uses) **–** Reciprocating pumps**,** Rotary pumps**,**Centrifugal pumps (Description and uses) **–** Characteristic curves of centrifugal pumps**,** Vacuum pumps and Jet Ejectors (Description and uses)**,** Fans, Blowers, and Compressors (Description and uses) – Fans, Blowers and Compressors – Positive-Displacement, Centrifugal

8 Measurement of flowing fluids

Full Bore Meters (Description, Application, and Simple Calculation), Venturimeter, Orificemeter, Area meter – Rotameter (Description, Application, and Simple Calculation), Pitot Tube (Description, Application, and Simple Calculation)

9 Fluidization

Introduction, Conditions of Fluidization, Types of Fluidization, Applications of Fluidization

Practical / Term-work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Book:

- Warren McCabe & Julin Smith; "Unit Operations of Chemical Engineering"

SEMESTER IV

1CHB03 ORGANIC CHEMISTRY

L	T	P	C
3	0	2	4

1. **Alkanes**
   Structure of methane – Chain reactions, Structure of ethane – Homologous series, Alkyl groups, Common names of alkanes – IUPAC names of alkanes, Nomenclature of cycloalkanes, Preparation of alkanes – Physical properties of alkanes, Reactions of alkanes – Halogenatio, Combustion, Pyrolysis
2. **Alkenes**
   Structure of ethylene – Geometrical isomers E and Z, Names of alkenes, Preparation of alkenes – Physical properties, Reaction of alkenes – Ozonolysis, Mechanism of Electrophilic addition
3. **Alkynes**
   Structure of acetylene, Nomenclature of alkyne, Preparation of alkynes, Reaction of alkynes
4. **Alcohol**
   Structure of alcohols, Preparation of alcohols, Physical properties of alcohol, Oxidation of alcohols, Iodoform test & Lucas test
5. **Ethers**
   Structure and nomenclature of ethers, Preparation of ether : Williamson synthesis, Preparation of ether : Alkoxymercuration – demercuration, Reactions of ethers : Cleavage by acid
6. **Aromaticity of Benzene**
   Stability of benzene ring, Orbital picture of benzene, Nomenclature of benzene derivatives
7. **Electrophilic aromatic substitution**
   Effect of substituent group – Classification of substituent group, Orientation in disubstituted benzenes, Orientation and synthesis – Mechanism of nitration, Mechanism of sulphonation, Mechanism of Friedel – Crafts alkylation – Mechanism of Halogenation, Mechanism of Friedel – Crafts acylation, Theory of reactivity
8. **Phenols**
   Structure and nomenclature – Physical Properties, Salts of phenols – Industrial Source, Ester formation : Fries – rearrangement – Kolbe reaction, Reimer – Tiemann reaction
9. **Aldehydes and Ketones : Nucleophilic Addition**
   Nomenclature, Preparation of aldehydes – Preparation of ketones, Reduction – Addition of Grignard reagents, Addition of cyanide, Addition of derivatives of ammonia, Addition of alcohols (Acetal formation), Cannizzaro reaction
10. **Carboxylic Acids**
    Structure – Nomenclature, Preparation, Physical properties – Salts of carboxylic acid, Industrial source, Carbonation of Grignard reagent – Hydrolysis of nitriles, Reactions

Practical / Term-work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Book

- V. D. Bhatt, S. S. Shah, Dr. K. D. Patel & Dr. B. C. Dixit ; "Organic Chemistry", Atul Prakashan
- Kumar & Mahnot ; "Fundamental organic chemistry", Ramesh Book Depot, Jaipur
- P. L. Soni ; "Fundamental organic chemistry", S. Chand & Sons
- B. S. Bahl, Arun Bahl ; "Elementry organic chemistry" , S. Chand & Co.

1CHB04 CHEMICAL PROCESS TECHNOLOGY – I

L	T	P	C
3	0	2	4

1 **Introduction to Chemical Process Technology**
   Unit operations (symbols) and unit processes, Batch and continuous processing, Flow charts

2 **Mineral acids**
   Properties and method of production of sulfur – Frasch process, Oxidation – Reduction process, Properties and method of production of sulfuric acid – Contact process, DCDA process, Nitric acid production , Phosphoric acid production

3 **Fuel gases, composition, properties, uses & brief manufacturing**
Producer gas, Water gas, Coke oven gas, Natural gas, LPG, Acetylene

4 **Industrial gases**
Carbon dioxide – From fuel oil and natural gas, From fermentation industries, Hydrogen – Electrolytic process, Steam Hydrocarbon reforming process, Partial oxidation method, Oxygen & Nitrogen – Process based on liquefaction, Process based on adsorption

5 **Coal & Coal chemicals**
Destructive distillation of coal, Cocking of coal, Principle of gasification and conventional gasifier, Introduction of Coal Chemicals

6 **Chlor – Alkali industries**
Properties, uses and method of production of soda ash – Solvay's Ammonia soda process, Dual process, Properties, uses and method of production of caustic – chlorine –Diaphragm cell, Membrane cell, Hydrochloric Acid Production, Major producers in Gujarat

7 **Cement and lime**
Properties and types of cement, Method of production – Cement rock benefication, Portland cement process, Poly phosphorus base cement, Properties and method of production of lime – Quick lime process, Hydrated lime process, Major producer in Gujarat

8 **Water and air**
Importance of water, Consumption of water, Water analysis, Method of treating raw water – Demineralization, Deionization and other chemical methods, Types of process water, Desalination of sea water, Recycling and reuse of process water, Uses of air as a chemical raw material and as utility

9 **Marine chemicals**
Bromine, Magnesium, Iodine (manufacturing of any one)

10 **Insecticides and Pesticides**
Properties, Outline method of production and application of - BHC, DDT

Practical / Term-work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Books

- "Dryden's Outline of Chemical Technology" ; Edt. By M. Gopal Rao & M. Sitting ' E.W. Publicaiton
- George T. Austin ; "Shreve's Chemical Process Industries", McGraw Hill Publication, Fifth Edition
- G. N. Pandey; "Chemical Process Technology"
- M. V. Naik ; "Chemical Process Technology" , Nirali Prakashan

1CHB06 INDUSTRIAL STOICHIOMETRY

L	T	P	C
3	0	0	3

1 **Mathematical principles**
Dimensions, Units, Conversion factors

2 **Basic Chemical Calculations**
Introduction, Mole, Atomic weight and Molecular weight, examples, Equivalent Weight, Normality, Molarity, Molality, Weight %, mole %, volume %, of S – S , S – L , S – G , L – L , L – G, G – G etc. mixtures, Hydrometers: ^{0} Baume , ^{0} Tweddle, ^{0}API, ^{0}Brix for measurement of specific gravity, Gases, Ideal gas law, Boyle's Law, Charle's Law, Gellusec's Law, Average molecular weight, Density of gas, Dalton's Law, Amagate's Law

3 **Material Balance Without Chemical Reaction**
Introduction, Process flow sheet, Material balance: simple numericals on material balance, Introduction to Recycling, bypassing and purging operation (without numericals)

4 **Material Balance With Chemical Reaction**
Introduction, conversion, yields, selectivity, % excess, Material balance with chemical reaction, Simple numericals based on above topics.

5 **Combustion**

Introduction, classification of fuels, Fuels, Calorific values of all types of fuels – Coal, Liquid fuel, Gaseous fuel, Air requirement and flue gases, analysis calorific value calculation, Numericals on calorific values air requirement & flue gas analysis.

6 **Energy Balance**

Introduction, Energy and Thermo chemistry, Energy Balances, Heat capacity, Heat capacity of gases at constant pressure, Sensible heat changes in liquids, Heat capacity of gaseous mixtures, Heat capacity of liquid mixtures, Latent heats, Enthalpy changes for pure substance and gas, liquid and vapour-liquid mixtures, Enthalpy changes accompanying chemical reactions – Hess's law of constant heat summation, Standard heat of formation, standard heat of combustion, standard heat of reaction, Simple illustrative numericals on above topics, Adiabatic reactions (Defination)

Text / Reference Book

- B. I. Bhatt & S. M. Vora ; "Stoichiometry" ,Tata McGraw Hill Publication
- Himmal bau ; "Stoichiometry"
- Hougen & Waston ; "Chemical Process Principles – I"

1CHB09 HEAT TRANSFER

L	T	P	C
3	1	2	5

1. **Fundamentals of Heat Transfer**

Introduction – Engineering Heat Transfer and Analogies between various transport Processes, Flow of electricity – Modes of Heat Transfer, Conduction – (Fourier's law), Convection – (Newton's law), Radiation – Steafan – (Boltz man law), Thermal conductance and resistance , Combined Heat Transfer process.

2. **Steady state Heat Transfer by conduction**

Linear one dimensional Heat conduction through, Cylinder, Sphere – Thermal diffusivity – Composite structure – Plane wall,Composite cylinder, Composite sphere – Critical insulation thickness of pipe

3. **Heat Transfer by Convection**

The Nature of Heat Convection – The Nusselt Number – Determination of Nusselt Number – Forced Convection (No Derivation) – Free Convection (No Derivation) – Laminar and turbulent flow in pipes & tubes: Sider – Tate equation, Dittus – Bolter equation ,etc.

4. **Heat Transfer with Change of Phase**

Heat Transfer accompanied by change of phase – Phenomenon of Boiling – Regimes of pool Boiling – The Nucleate Boiling and Film boiling – Phenomena of Condensation (Film wise and Drop wise).

5. **Thermal Radiation**

Nature of Thermal Radiation – Absorption, Transmission, Reflection and Emission of Radiation – Emissive Power of black Body, Planck's Distribution Law. – Total Emissive Power; Stefan-Boltzmann law – Emissivity – Kirchoff's law – Black body – Radiation shields

6. **Heat Exchangers**

Introduction, Heat exchangers types – Shell and Tube Heat exchanger, Double pipe and Hair pin heat exchanger, Condenser: Horizontal and Vertical, Reboiler: Horizontal and Vertical, Plate and Spiral heat exchanger, Fin and extended surface exchanger, Overall Heat Transfer Coefficient, Effect of scale formation, Logarithmic Mean Temperature Difference, L.M.T.D. correction Factors, Heat Exchanger Effectiveness (without NTU)

7. **Evaporation**

Introduction, Liquid characteristic, Types of evaporator – Long tube evaporator, Agitated film evaporator, Durhing rule & boiling point elevation, Economy & capacity, Method of feeding, Examples based on single effect evaporator

Tutorials: It will consist of minimum of ten tutorial assignments.

Practical / Term-work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Book

- McCabe & Smith ; "Unit Operation", McGraw Hill Publication.
- Gupta and Prakash ;" Engineering Heat Transfer", Nemchand & Bros.
- J. P. Holman ;"Heat Transfer"
- D. Q. Kern ; " Process Heat Transfer" Tata McGraw Hill Publication.
- Sachendra ; "Fundamental of heat transfer and mass transfer"

1CHA01 MASS TRANSFER – I

L	T	P	C
3	1	2	5

1. **The Mass Transfer Operation**
   Classification of mass-transfer operations, Choice of separation methods, Methods of conducting the mass-transfer operations, Design principles
2. **Molecular Diffusion in Fluids**
   Steady-state molecular diffusion in fluids at rest and in laminar flow – Molecular diffusion in gases, Diffusion of A through non diffusing B, Steady state equimolar counter diffusion, Diffusivity of gases, Molecular diffusion in liquids, Diffusivity of liquids, Introduction to Diffusion in Solids – Fick's Law for diffusion in solids
3. **Mass-Transfer Coefficients**
   Mass-transfer coefficients in laminar flow, Mass-transfer coefficients in turbulent flow – Film theory, Penetration theory, Mass, Heat, and Momentum-transfer analogies, Mass-transfer data for simple situations, Introduction to Simultaneous Mass and Heat transfer
4. **Interphase Mass Transfer**
   Concept of Equilibrium, Diffusion between phases – Interphase Mass Transfer – Two Resistance Theory, Local phase Mass Transfer Co-efficient, Relation between Overall and Local Mass Transfer Co-efficient, Material balances – Co-current steady state process, Counter current steady state process, Stages & Cascades – Cross flow cascades, Counter current cascades
5. **Equipment for gas liquid operations**
   Gas dispersed equipments – Sparged vessels, Mechanically agitated vessels, Tray towers, Liquid dispersed equipment – Venturi scrubbers, Wetted wall towers, Spray towers and Spray chambers, Packed towers, Components and pressure drop in tray & packed tower.
6. **Humidification Operation**
   Vapor-Liquid equilibrium and Enthalpy for a pure substance, Vapor-Gas mixtures (Related to psychometric chart only) – Absolute humidity, Saturated vapor gas mixture, Unsaturated vapor gas mixture, The system air-water, Adiabatic saturation curves, Wet bulb temperature, Gas liquid contact operation (No numerical) – Water cooling with air, Dehumidification of air – water vapor, Water cooling towers (Types, operation, performance), Spray ponds
7. **Absorption and Stripping**
   Equilibrium solubility of gases in liquids – Two component system, Ideal liquid solutions, Non ideal liquid solutions, Choice of solvent for absorption, One component transferred; Material balances – Countercurrent flow, Cocurrent flow, Countercurrent multistage operation; One component transferred – Dilute gas mixtures, The absorption factor, Real trays and tray efficiency, Continuous contact equipment – Absorption of one component, Height equivalent to an equilibrium stage, Introduction to Absorption with chemical reaction, Industrial applications of absorption & stripping

Tutorials: It will consist of minimum of ten tutorial assignments.

Practical / Term-work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Books:

- Robert E. Treybal; "Mass Transfer Operations", Mc Graw Hill Publication, IIIrd Ed.
- V. Katarov; "Fundamentals of Mass Transfer" , Mir Publisher
- W. L. Badger & J. T. Banchero ; "Introduction to Chemical Engineering", McGraw Hill 1995
- S. K. Ghosal, S. K. Sanyal, S. Datta ; "Introduction to Chemical Engg." ,Tata McGraw-Hill Pub. 1996.

Nirma University of Science and Technology
Institute of Diploma Studies
Course Structure for Third Year of Diploma in Chemical Engineering

Semester –V

Sr. No.	Course Code	Course Name	Teaching Scheme				Examination Scheme					
			Hours / Week			Credit	Hours		Examination Weightage			
			L	T	P		MSE	SEE	MSE	SEE	TA	LPW
1.	1CEH06	Computer Programming	2	-	2	3	1.5	3	0.20	0.40	0.15	0.25
2.	1CHB05	Chemical Process Technology-II	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
3.	1CHB08	Mechanical Operation	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
4.	1CHA02	Mass Transfer-II	3	1	2	5	1.5	3	0.20	0.40	0.15	0.25
5.	1CHA03	Safety Management in Chemical Industries	3	-	-	3	1.5	3	0.25	0.60	0.15	-
6.	1CHA04	Computer Aided Drawing in Chemical Engineering	-	-	4	2	-	-	-	-	-	1.00
		Total:	**14**	**1**	**12**	**21**						

Semester –VI

Sr. No.	Course Code	Course Name	Teaching Scheme				Examination Scheme					
			Hours / Week			Credit	Hours		Examination Weightage			
			L	T	P		MSE	SEE	MSE	SEE	TA	LPW
1.	1CCS02	Non-Conventional Energy Sources*@	9	-	-	3	1.5	3	0.25	0.60	0.15	-
2.	1CCS05	Interpersonal Skills*@	6	3	-	3	1.5	3	0.25	0.60	0.15	-
3.	1CHT01	Industrial Training-(Phase-I)**	-	-	-	10	-	-	-	-	-	1.00
		Total:	**15**	**3**	**-**	**16**						

L- Lecture, T- Tutorial, P-Laboratory / Project Work (LPW) , TA - Term Assignments, MSE - Mid Semester Examination, SEE - Semester End Examination

*5 Weeks Full Time **10 Weeks Full Time

@ From Annexure - V

THIRD YEAR OF DIPLOMA CHEMICAL ENGINEERING

SEMESTER V

1CEH06 COMPUTER PROGRAMMING

L	T	P	C
2	0	2	3

1. **Introduction**
   Algorithms, Flowcharts, Basic structure of C programs, Programming style, execution of C program
2. **Constants, variables and data types in C**
   Character set, C tokens, keywords and identifiers, constants, variables, data types, declaration of variables, value assignment, symbolic constants
3. **Operations and Expression**
   Arithmetic, relational, logical, assignments, increment, decrement conditional, bitwise and special operators. Arithmetic expression, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions
4. **Date Input and Output**
   Reading and writing a character, formatted input and output
5. **Control Statements**
   IF and IF ELSE statements, Nesting, ELSE IF, switch statement, ?: operator, GOTO statement
6. **Looping**
   WHILE, DO-WHILE and FOR statements, BREAK and CONTINUE statements
7. **Arrays**
   Introduction, One dimensional, two dimensional array and their initialization, multidimensional array
8. **Character strings**
   Declaring and initializing, reading and writing strings, comparison of strings, strings – handling functions
9. **Functions**
   C functions, necessity, form of C functions, return values and their types, calling and nesting of functions, category of functions, recursion, functions with arrays
10. **Structures:**
    Introduction, Structure definition, Giving values to members, Structure initialization, assignment of values, arrays of structures
11. **File Management in C:**
    Defining, opening and closing a file, Input, output operations on file, random access to files
12. **Preprocessor:**
    Introduction, Macro substitution, File inclusion

Practical / Term - work - Practical / term-work will consists eight practicals based on above topics.

Text / Reference Books:

- Programming in ANSI C; E. Balagurusamy, TMH
- Programming with C; Byron S. Gottfired, Schaum series, TMH
- The spirit of 'C' ; Mullish Cooper, Jaico Publishing House

1CHB05 CHEMICAL PROCESS TECHNOLOGY – II

L	T	P	C
3	0	2	4

1 **Carbohydrates & Fermentation industries**
   Introduction to carbohydrates, Mfg. of sugar, Classification of starch & their properties, Mfg. of starch from maize, Characteristics of fermentation process, Manufacture of ethylalcohol from agrowaste and bagasse

2 **Paint, Pigments, Varnishes & Lacquers**
   Constituents, Mfg. of Pigments (TiO_2), Mfg. of paints, Application of paints, Varnishes, Lacquers

3 **Oil – Soaps and Detergents**
   Introduction of oil, soaps & detergents, Types of oils, fats – Edible oil, Non – edible oil, Extraction of

vegetable oil, Analysis of oil – Acid value, Saponification value, Iodine value, Types of fats, Mechanism of soap & detergent action, Outlines of method of production of soap (cold, semiboiled and full boiled), continuous, Types of soap – Washing soap, Toilet soap, Industrial soap, Outlines of method of detergent manufacturing, Synthetic detergents and surfactants

4 Pulp, Paper & Rayon

Manufacture of pulp – Sulfate (Kraft) pulp process, Sulfite pulp process, Recovery from sulfate pulp digestion liquor, Paper – Method of Production, Rayon – Cellulose fiber & its derivatives

5 Nuclear materials & Explosives and Propellants

Nuclear fission and fusion reaction, Method of production – Uranium, Deuterium, Heavy water (D_2O), Types of explosives, Types of propellants

6 Pharmaceutical Industries

History & Growth of industries, Classification as per chemical conversion, Various drugs and pharmaceuticals based on following unit process – Alkylation, Carboxylation & acetylation, Condensation & cyclization, Dehydration, Helogenation, Oxidation, Sulfonation, Amonation, Types & classification of Antibiotics – Penicillin, Illustrative manufacture process of one antibiotics

7 Polymerization Technology

Introduction – Physical properties & basics of polymerization methods & techniques, Manufacturing process for Ethenic polymer, Outline manufacture process for PVC, Outline manufacture process for Nylon 6,6

8 Intermediates & Dyes

Classification of Dyes, Intermediate based on unit processes

Practical / Term - work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Books:

1 "Dryden's Outline of Chemical Technology" ; Edt. By M. Gopal Rao & M. Sitting 'E.W. Publicaiton
2 George T. Austin ; "Shreve's Chemical Process Industries", McGraw Hill Publication, Fifth Edition
3 G. N. Pandey ; "Chemical Process Technology",Vikash Publicatiion
4 M. V. Naik ; "Chemical Process Technology" , Nirali Prakashan

1CHB08 MECHANICAL OPERATIONS

L	T	P	C
3	0	2	4

1 Properties of Particulate Solids

Characterization of solid particles, Particle shape – Sphericity, Particle size – Mixed particle sizes and size analysis, Specific Surface of mixture, Average particle Size, Number of particles in mixture, Screen analysis – Standard screen series, Differential analysis, Cumulative analysis, Equipments for screen analysis – Gyrating screen, Vibrating screen, Trommels, Grizzlies

2 Size Reduction

Principles of comminution, Energy and power requirement – Crushing efficiency, Empirical relationships – Rittinger's law, Kick's law, Bond's law, Size reduction equipment – Crushers, Jaw crushers, Gyratory crushers, Roll crushers, Grinders – Hammer mills, Rolling compression mills, Attrition mills, Tumbling mills, Ultra fine grinders: Hammer mills with internal classification, Fluid energy mills, Agitated mills, Cutting machines: Knife cutters, Introduction to Size Enlargement

3 Agitation and Mixing of Liquids

Agitation of liquids – Purpose of Agitation, Agitation Equipment (Description and Applications) – Impellers, Propellers, Paddles, Turbine, Flow patterns in agitated vessels – Prevention of swirling

4 Mixing of Solids

Types of mixers (Description and Applications) – Change – Can mixers, Kneaders, Banbury mixers, Pug mills, Ribbon blender

5 Filtration

Mechanism of filtration, Cake filters – Discontinuous pressure filters – Plate and frame filter press, Shell-and-leaf filters, Automatic belt filter, Discontinuous vacuum filters, Continuous vacuum filters – Rotary – drum filter, Horizontal belt filter, Centrifugal filters – Suspended batch centrifuges, Automatic batch centrifuges, Continuous filtering centrifuges, Clarifying filters – Liquid clarification, Gas cleaning Principles of cake filtration – Pressure drop through filter cake, Compressible and incompressible filter cakes, Filter medium resistance, Constant pressure filtration, Empirical equation for cake resistance, Constant rate filtration, Principals of Centrifugal filtration, Washing filter cake, Types filter media and filter aids

6 Sedimentation

Gravity settling processes – Gravity classifiers, Sorting classifiers – Sink-and-float methods, Differential settling methods, Sedimentation – Rate of sedimentation, Batch and continuous sedimentation, Flocculation, Thickeners

7 Conveying of Solids

Belt conveyers, Chain conveyers, Bucket conveyers, Screw conveyers, Pneumatic conveyers.

8 Separation based on property

Froth flotation, Magnetic separation, Electrostatic precipitator, Jigging, Cyclone, Bag filter, Hydrocyclones.

Practical / Term-work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Books:

- McCabe & Smith; "Unit operations of Chemical Engineering",Tata McGraw Hill Publication

1CHA02 MASS TRANSFER – II

L	T	P	C
3	1	2	5

1. Distillation

Vapor-Liquid equilibria – Pressure-Temperature-Concentration Phase diagram, Constant pressure equilibria, Relative volatility, Constant temperature equilibria, Ideal solutions – Raoult's law, Single-stage operation – Flash vaporization, Differential or Simple Distillation, Continuous rectification – Binary systems, Multistage tray towers – Method of McCabe and Thiele – Enriching section, Exhausting section, Introduction of feed, Location of the feed tray, Infinite reflux ratio and Minimum reflux ratio, Continuous contact equipment (Packed towers) – HTG, NTG, HOG, NOG: Calculations only

2. Crystallization

Introduction – Importance of crystal size

Crystal geometry – Crystallographic systems, Invariant crystals, Crystal size and shape factors, Super saturation, Nucleation and growth (brief introduction), Crystallization equipments – Methods to produce super saturated solutions, Variation in crystallizers, Vacuum crystallizers, Draft tube baffle crystallizer

3 Introduction to Membrane separation processes

Types of membranes, Membrane separation processes (brief introduction) – Reverse osmosis, Micro-filtration, Ultra-filtration, Dialysis, Pervaporation, Permeation

4 Liquid – Liquid Extraction

Definitions, Fields of usefulness, Liquid equilibria – Equilateral Triangle coordinates, System of Three liquids – One pair partially soluble, System of Three liquids – Two pair partially soluble, System of Two pairs partially soluble liquids and One solid, Other coordinates, Choice of solvent for liquid – liquid extraction, Single stage extraction, Equipments – Stage type extractor – Settlers, Mixer-settler cascade, Sieve tray tower, Differential (continuous contact) Extractor – Spray tower, Mechanically agitated, Countercurrent extractor, Pulsed column, Centrifugal extractor

5. Leaching

Preparation of the solid, Temperature of leaching, Unsteady state operation – In – place (in situ) leaching, Heap leaching, Methods of calculations – Stage efficiency, Practical equilibrium, Single stage leaching, Equipments – Percolation tank, Shank system, Agitated vessels, Classifiers

6. Drying

Equilibrium – Insoluble solids, Hysteresis, Soluble solids, Definitions, Rate of batch drying – Drying tests, Rate of drying curve, Time of drying, Drying operations – Batch drying and Continuous drying, Direct driers, Indirect driers, Drying equipments – Tray driers, Rotary driers, Drum driers, Spray driers

7 Adsorption and Ion exchange

Types of Adsorption, Nature of Adsorbent, Adsorption equilibria, Single gases and vapors, Adsorption Hysteresis, Heat of adsorption, Adsorption from dilute solution: The Freundlich equation, Ion Exchange, Principles, Applications with respect to D. M. water

Tutorials: It will consist of minimum of ten tutorial assignments.

Practical / Term-work - Practical / term-work will consists minimum ten experiments based on above topics.

Text / Reference Books:

- Robert E. Treybal; "Mass Transfer Operations", Mc Graw hill Publication; III Ed.
- McCabe & Smith ; "Unit operation of Chemical Engineering"
- V. Katarov; "Fundamentals of Mass Transfer", Mir Publisher
- W.L. Badger & J. T. Banchero; "Introduction to Chemical Engineering" ,McGraw Hill 1995
- S. K. Ghosal, S. K. Sanyal, S. Datta ; "Introduction to Chemical Engg." , Tata McGraw-Hill Pub. 1996.

1CHA03 SAFETY MANAGEMENT IN CHEMICAL INDUSTRIES

L	T	P	C
3	0	0	3

1. General Introduction & concept of safety

Concept of Safety, Importance of Safety in Chemical Industries, Intrinsic & Extrinsic Safety

2. Occupational Health & Safety Hazards

Introduction to Occupational Health Hazards, Toxicological Studies: Acute & Chronic effect, Ways of Entrance of Toxicants in body & tolerance limits, First aid measures, Toxicity index, Definition, Calculation and interpretation of Threshold Limit Value (TLV), Material Safety Data Sheet (MSDS), Safe transportation of hazardous chemicals

3.

Pressure & Temperature related safety

Introduction to Pressure Relief System and related terms, Pressure relief devices: Types of pressure relief devices and their functioning, Criteria for selection of pressure relief devices, Temperature relief devices, Hotspots effect in fired heater, Runaway reactions, Thermal relief devices: Temperature Relief Valve (TRV)

4 Fire, Explosion and its prevention

Fire: Introduction of Fire: Fire triangle and Fire tetrahedron, Classification of fire: Class A, B, C, D , Terms related to Fire: Flash Point, Fire Point, Auto Ignition Temperature, Lower Flammable Limit, Upper Flammable Limit

Factors affecting LFL and UFL, Explosion: Introduction, Classification of Explosion: Detonation, Deflagration, Confined explosion, Boiling liquid expanding vapor explosion,Terms related to Explosion: Lower Explosive Limit, Upper Explosive Limit

Prevention of Fires & Explosion: Different types of Fire Extinguishers and their application, Inerting, Static Electricity, Ventilation, Sprinkler, Deluge and Foam System, Fire and Gas detection system and their upkeep

5.

Accident and its prevention

Causes of accident and their effect, Accident investigation and preparation of report, Accident statistics, Prevention of accident

6 Introduction to Dow Fire & Explosion Index

Dow Fire & Explosion Index: Types of process hazards and factors affecting hazards

7 Loss Prevention & Techniques for Hazard Identification

Introduction to Hazard Identification Techniques: Introduction to Fault Tree Analysis and Risk Assessment, Hazard Operability Studies (HAZOP): Basic Principles, Key words, Procedure, A Case Study of HAZOP

8

Safety of Plant and Equipments

Safety in the equipments: Reactors, Process Equipments, Piping, Furnaces and Boilers, Rotating Equipments, Storage Vessels, Electrical Equipments

9 Case Studies of Indian Industries

Simple Case Studies on: Static Electricity, Chemical Reactivity, System Design, Procedures

10 Personal Protective Equipments

PPEs and their uses: Hand gloves, Goggles, Ear plug, Gum Shoes, Apron, Mask, Helmet

11 Legal Aspects of Safety in Chemical Industry

Safety Regulations: Gujarat Factory Act, 1948: Introduction to following, Stability certificate, Onsite emergency plant, Safety work permit system, Publishing of Hazardous material information, Periodic Medical check-up, Safety Audit

Text / Reference Books:

- Daniel A. Crowl & Josheph F. Lowar ;"Chemical Process Safety, Fundamental with Applications", Prentice Hall Publication
- F. I. Khan & S. A. Abbasi ; "Risk Assessment in Chemical Process Industries"
- Trevor Keltz ; "HAZOP & HAZAN"
- John V. Grimaldi ; "Safety Management"
- Industrial Safety- Uday Chakraborty
- Classification of Hazardous Locations –A.W. Cox
- Safety Management in Industries-N.V.Krishnan
- What when Wrong? Trevor Kletz
- Loss Prevention Association Journal

1CHA04 COMPUTER AIDED DRAWING IN CHEMICAL ENGINEERING

L	T	P	C
0	0	4	2

1. Introduction To AutoCAD and its Applications

Hardware and software of AutoCAD, Features of AutoCAD, Input Devices, Creating a new drawing, prototype creation, Opening and saving of drawing, Use of menu systems: pull down menu, cursor menu, floating/docked pallets with flyouts, side screen menu, Use of Key board input, Setting of units and limits of a drawing

2. Drawing Commands

Understanding Co-ordinate Systems: Absolute Co-ordinates, Relative Co-ordinates, Polar Co-ordinates, Creation of lines and polylines, ARC command, Creating Circles and Ellipse, Drawing of uniformly shaped polygon

3. **Editing Commands**

Selection of geometry with various options, Creation of groups, Cleaning up a drawing : ERASE, UNDO, REDO, Commands for positioning objects : MOVE, ROTATE, STRETCH, SCALE, Commands for changing an entity's length: TRIM, EXTEND, LENGTHEN, BREAK, Construction editing commands: COPY, MIRROR, OFFSET, ARRAY, FILLET, CHAMFER, Setting of object creation modes, Modifying an entity by DDMODIFY command

4. **Precision Input Commands, Annotating the Drawing and Plotting**

Precision Input Commands – Controlling the Environment with Drawing Aids dialogue box:, Blips, Highlighting selected objects, Solid fill display, Grid reference, Snap to reference grid, Ortho tool, Transparent commands: ZOOM, PAN , REDRAW, Object Snaps and Running object snap, Creating complex object with BLOCK and WBLOCK, Annotating the Drawing – Dimensioning the object:, Setting the Dimension style, Linear Dimension, Aligned Dimension, Radial Dimension, Angular Dimension, Ordinate Dimension, Baseline Dimension, Continue Dimension, Leader Dimension, Cross-Hatching, Writing Text with – TEXT, DTEXT, MTEXT, Use of layer to organize the drawing: Creating and controlling the layers with DDLMODES**,** Plotting the AutoCAD drawing

5. **Introduction to 3D drawing**

3D drawing using Isometric grid, 3D drawing using Solids and surfaces
Preparation of 3D solids using commands: extrusion, revolve, etc.

6. **Introduction to Pro-Engineer Software**

Pro/draw – Define multiple drawing views, Create geometry with user friendly mouse and keyboard interface, Modify geometry easily using a comprehensive set of tools, Fully annotate drawing adhering to industrial standards, Solid modeling with Pro/engineer. (Pro/part) – Feature based, associative and parametric solid modeling, The screen layout, pull down menu, toolbars, display area, message area, Types of sketched feature: Protrusion cut and slot, Use of base feature and datum plane, Extrude, sweep, blend, and Revolve, Duplication: copy, mirror, and pattern.

7. **Introduction to AutoLISP**

Understanding the AutoLISP interpreter, AutoLISP Expressions, Variables and Data Types, Functions used in AutoLISP: Setq, car, cdr, getpoint, getcorner, Introduction to functions for obtaining user input, like getint, getreal, getpoint, getstring, getangle, An AutoLISP programme to create BOX

8. **Process Flow Diagrams**

Block Diagrams & Process Flow Diagrams (PFD) – Utility Line Diagrams (ULD) & Utility Block Diagrams (UBD), Engineering Line Diagrams & Piping and Instrumentation Diagram (PID)

9. **Plant & Piping Layout**

Typical Plant layout and Piping layout

10. **Shell and Tube Heat Exchanger**

Types of heat exchanger, Flow arrangement, Tubes and Tube sheet layout, Shell & tube side passes

11. **Tray Towers & Packed Towers**

Tray Tower: Fractionating Column: Shell, Head, Support, Tray types, Downcomer and weirs, Flow Pattern on tray, Feed systems, Vapor outlet, Bottom outlet, Man hole, Ladder, Platform, Packed Tower: Shell, Manhole, Support, Vapor outlet, Packing materials, Types of packing, Liquid collector, Liquid distributor

12. **Storage Vessels**

Storage of liquids, Standard free roof cylindrical tanks, Standard fixed roof storage tanks, Variable volume tanks, Storage of gases – Spherical vessels or Hortonspheres

13. **Reaction Vessels**

Classification of reaction vessels, Heating and Cooling systems: Jackets, Coils

14. **Supports and Heads**

Supports – Bracket or lug support, Skirt support, Saddle support, Heads or Closures – Plain formed head, Flared and dished head, Shallow dished head, Torispherical dished head, Elliptical head, Hemispherical head, Conical head

Note: All the topics will be taught on computer during practical.
Practical / Term-work - Practical / term-work will consists minimum twenty sketches based on above topics.
Text / Reference Books:

- Jhon W. Gibbs ; "Teach Your self AutoCAD Release 13 for Windows"
- M. V. Joshi ; "Process Equipment Design", MACMILLAN India Ltd. 1996 ed.
- K .A. Gavhane; "Chemical Engineering Drawing", Nirali Publications
- By Experts; "Inside AutoCAD Release 13 for Windows and Windows NT", Prentice Hall Publications
- George Omura; "Mastring AutoCAD 13 for Windows ", BPB Publications
- Krik Othmer; "Encyclopedia of Chemical Technology", Volume - 19
- Robert E. Treybal; "Mass Transfer Operation"; TMH Pub., 3rd ed.
- Max S. Peters, Kalus D. Timmerhaus; "Plant Design and Economics for Chemical Engineering", McGraw-Hill International Edition
- Richardson and Couluson; "Chemical Engineering"

(SEMESTER VI)

1CCS05 INTERPERSONAL SKILLS*

L	T	P	C
6	3	0	3

1. **Introduction to Human Resource Management**
   Need and scope of human resource management in industrial environment, Impact of human factors on productivity and industrial harmony
2. **Human Need, Relations and Values**
   x and y theory, Importance of human resources, Maslow's hierarchy, its importance in managing human resources, Need of human relations and human values in the industry, Desirable human values and their importance including ethics and morale value
3. **Behavioural Dynamics**
   1. Interpersonal Behaviour
      Introduction, Need for interpersonal competence, Determinants of interpersonal behaviour
   2. Leadership
      Situational approach to leadership, Power influence and compliance, Influence of leadership, Techniques to deal people effectively
   3. Group Dynamics
      Concept of group dynamics, Dynamics of group formation, Types of group, Role of group in organization, Desirable characteristics of group member
   4. Attitude
      Concept & importance of positive attitude and openness of mind, Do's and don'ts for developing positive attitude, Importance of mental health
4. **Supervisor's Role in HRD**
   Importance of HRD, Need, importance & types of Training, Need and importance of Motivation, Supervisor's role as Trainer & Motivator, Need, importance and use of Counselling and Mentoring
5. **Decision Making**
   Importance of decision making in context of productivity, quality, cost consciousness, human relations and goal achievement, Factors affecting, Types and process, Make the decisions for given case / situation
6. **Management of Change**
   Need of change, Barrier to change, Strategies to manage change (Effective implementation and management of change), Trade unions and their objectives, Constructive role of trade unions in goal setting, achievement and change management, Causes and resolution techniques of conflicts
7. **Stress Management**
   Concept of stress management, Attributes of stress, Stress measuring techniques, Techniques to relieve the stress.

8. **Communication**
   1. Communication
      Concept and definitions, Objectives, Types: downward, upward, lateral, grapevine
   2. Proposals and Reports
      Introduction, Features / Characteristics, Structure, Forms / Types
   3. Business letters
      Introduction, Form: Block, Indented Characteristics, Structure, Types of Business letters
   4. Group Discussion and Meetings
      Communication skills to be developed

Tutorials: It will consist of minimum of ten tutorial assignments.

Text / Reference Books

- Managing people at work, Ahuja, Jain & Chhabra, Dhanpat Rai and Sons. Allahabad 1997.
- Maximising leadership effectiveness. Astin, A. W. Scherrei R.A., Jossey-Bass Publishers, Londo, 1980.
- Motivation and management development, Butterworthsand Tamrehill R.E. 1970.
- Improving performance at work, Dessler, Garry, Reston Publishing Co. Inc. A prentice Hall Co. Reston, 1979.
- Management of Organisational behaviour, Hersey and Blanchard, Prentice Hall, India, 1977.
- People in organisations, Mitchel, Terence R., McGraw Hill, Koga-kusha, Ltd. Tokyo, 1978.
- Designing and Managing human resources systems, Pareek, Udai and Rao T.V., Oxford and TBH Publishing Co. New Delhi, 1981.
- Behavioural processes in organisation, Pareek, Udai and Rao T.V., Oxford and TBH Publishing Co. New Delhi, 1981.
- Practical guide to managing people, Parkar Publishing Co., Inc., New York, 1975.
- Organisational Psychology, Schein, Edgar H. Prentice Hall Inc., New Jersey, 1970.
- Stress for success, Van Nostrand Reinhold Co., Morse and Furst, 1979.

* 5 weeks teaching phase.

1CCS01 ENTREPRENEURSHIP DEVELOPMENT*	**L**	**T**	**P**	**C**
	9	0	0	3

1. **Entrepreneur, Entrepreneurship and Enterprisevital link for economic development.**
   Understanding the concept of Entrepreneur, Entrepreneurship and importance of small enterprises for the economic development of the country. Who can be an Entrepreneur? Why Entrepreneurship? What are the qualities and traits of successful Entrepreneur? Self-assessment.
2. **Entrepreneurship as a career choice**
   Why should we encourage Entrepreneurship? Importance of being Entrepreneurial. Benefits to individual, organisation and society.
3. **Resource mobilization form 'Support System'**
   Whom to contact for what?, Assistance and incentives available from Central/state Government, [IC/DIC], Small industry Development Bank [SIDBI], State Finance Corporations [SFCs] and various other agencies.
4. **Achievement Motivation Training. (AMT)**
   Developing Entrepreneurial Personality. Achievement motivation Training [AMT] and Developing Entrepreneurial Competencies. Specialized inputs of twelve hours based on Behavioral science exclusively designed for developing Entrepreneurial attitude among the students.
5. **Business Opportunity Identification and Selection [BOI]**
   How to identify and select a Business Opportunity? What are the processes and techniques? How to use brain storming technique? Methods of Environment scanning and data collection. Understanding BOI process. Products profile preparation and product selection.

6. **Market Survey tools and techniques**
   What are Market Survey? How to carry out Market survey? What are tools and techniques? How to prepare questionnaire? How to undertake field survey? How to write market survey report? Assignment of preparing market survey report.
7. **Preliminary Project Report [PPR]**
   What is PPR? Why PPR? How to prepare PPR? Assignment for preparing PPR.

NOTE: Following thing are required to be included at a specific time during the course study.

6. Visit to small scale units: - Minimum five to seven different types of units must be shown to students. Profile of these units to be kept ready prior to visit. Students will have to work in small groups to complete the assignments based on these visits. A presentation by a group leader to be followed on the next day of the visit.
7. Details of existing SSI units in and around Ahmedabad and its data to be maintained at the department.
8. Special guest lectures of successful entrepreneurs to be organised as and when possible for better interaction with the students.
9. More inputs on establishing SSI unit and preparation of detail project report to be included during last semester.
10. More inputs on Management of SSI and strategies for growth to be included in the last semester.

Text / Reference Book

- A hand book for New Entrepreneurs By EDI, Ahmedabad

* 5 weeks teaching phase.

Nirma University of Science and Technology
Institute of Diploma Studies
Course Structure for Fourth Year of Diploma in Chemical Engineering

Semester –VII

Sr. No.	Course Code	Course Name	Teaching Scheme				Examination Scheme					
			Hours / Week			Credit	Hours		Examination Weightage			
			L	T	P		MSE	SEE	MSE	SEE	TA	LPW
1.	1CHA05	Chemical Process Control & Instrumentation	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
2.	1CHA06	Pollution Control & Waste Disposal	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
3.	1CHA07	Petroleum Refining & Petro Chemicals	3	-	2	4	1.5	3	0.20	0.40	0.15	0.25
4.	1CHA08	Fertilizer Technology	3	-	-	3	1.5	3	0.25	0.60	0.15	-
5.	1CHD0	Advance Technology Course-I***	3	-	-	3	1.5	3	0.25	0.60	0.15	-
6	1CHD0	Advance Technology Course-II***	3	-	-	3	1.5	3	0.25	0.60	0.15	-
		Total:	**18**	**-**	**6**	**18**						

Semester-VIII

Sr. No.	Course Code	Course Name	Teaching Scheme				Examination Scheme					
			Hours / Week			Credit	Hours		Examination Weightage			
			L	T	P		MSE	SEE	MSE	SEE	TA	LPW
1.	1CHA09	Project*	-	-	18	3	-	-	-	-	-	1.00
2.	1CHT02	Industrial Training (Phase-II)**	-	-	-	10	-	-	-	-	-	1.00
		Total:	**-**	**-**	**18**	**13**						

L- Lecture, T- Tutorial, P-Laboratory / Project Work (LPW), TA - Term Assignments, MSE - Mid Semester Examination, SEE - Semester End Examination

*5 Weeks Full Time ** - 10 Weeks Full Time

***From Annexure-I

FOURTH YEAR DIPLOMA CHEMICAL ENGINEERING

Semester –VII

1CHA05 CHEMICAL PROCESS CONTROL & INSTRUMENTATION

L	T	P	C
3	-	2	4

1 Introduction to process control

The system, Steady state & unsteady state systems, Process control – Feed back control loop, Integral control

2 Laplace Transforms

Defination, Laplace Transforms of Step, Exponential, Ramp, Sine functions, Laplace Transforms of derivatives, Inverse Laplace Transformations (simple)

3 Response of first order systems

Mercury thermometer, Properties of transfer function, Response of Step & Impulse functions, Examples based on above topics, Different examples of first order systems : Liquid Level, Mixing Process, RC-Circuit, Non-interacting Tanks in series etc, Introduction to Second order System

4 Control system

Components of control system, Feedback system (Positive & Negative), Servo & Regulating Control, Final Control Element: Control Valve – Construction, Classification, Valve Actuator, Valve Positioners, Characteristics (only types)

5 Controllers

Classification of controllers: Hydraulic, Pneumatic, Electronic etc, Electronic Controllers: On-Off, P, PI, PD & PID Controllers, Introduction to PLC: background, components, Tasks, Features, Introduction to DCS

6 Elements of Measurement Instruments

Primary and secondary elements, Manipulating and functioning elements, Static characteristics, Dynamic characteristics

7 Measurement of Temperature

Temperature scales, Expansion & filled system thermometers, Electrical temperature sensors: RTD, Thermister, Thermocouple, Pyrometers

8 Measurement of pressure

Manometers, Elastic Pressure Transducers, Forced balanced pressure Gauge, Measurement of differential pressure, Vacuum measurement, Protection of Pressure Gauges, Comparison of pressure sensors

9 Measurement of level

Direct level measurement, Indirect level measurement

10 Measurement of flow

Head flow meters, Variable area flow meters, Positive displacement flowmeter, Velocity flowmeter, Flow Integrators and Electromagnetic flow meters, Comparison of flowmeters

11 Instruments for

Measurement of density & specific gravity, Measurement of viscosity, Measurement of humidity

Practical / Term-work - Practical / term-work will consist of minimum ten experiments/ exercises based on above topics.

1CHA06 POLLUTION CONTROL & WASTE DISPOSAL

L	T	P	C
3	-	2	4

1 Introduction to Pollution

Introduction to environmental pollution – Definition of pollution, Definition of pollutant, Pollutants – Natural sources, Agricultural sources, Process industry, Effect of pollution – Effect on human health, Damage of vegetation & animal life, Effect on environment. e.g. Rivers, Sea etc, Green house effect, Acid raining, Ozone depletion, Al-nino effect

2 **Air pollution sources & Effects**

Sources & Types of air pollutant (e.g. Vehicular, Industrial, Power plants), Classification & properties of air pollutants, Effect of Air pollution, Smog, Photochemical smog (only brief introduction)

3 **Air pollution sampling & Measurement**

Types of pollutant sampling & measurement, Ambient air sampling, Stack sampling of Process gases & Flue Gases

4 **Air pollution control methods & Equipments**

Particulate control – The basic mechanism – Gravitational settling, Centrifugal Impaction, Direct Interception, Diffusion, Electrostatic precipitation, Equipments – Gravity setting chamber, Cyclone separator, Fabric filters, Electrostatic precipitator, Wet collectors (scrubber)

5 **Control of Specific Gaseous Pollutants**

Control of SO_2 Emission – Extraction of sulfur from fuels, Sulfur reduction during combustion, Desulfurization of flue gases, Control of Nitrogen Oxides, Modification of Operating Condition, Modification of Design Condition, Effluent Gas treatment methods, Carbon Monoxide Control, Hydrocarbon Control

6 **Water Pollution**

Utilization of water, Characterization of water: BOD, COD, VM, Suspended Matter, Dissolved solids, Pollution of water, Classification of water pollution, Water pollution sources

7 **Waste Water Treatment**

Introduction, Composition of sewage, Examination of sewage, Sewage treatment processes – Primary treatment, Secondary treatment, Final or Advance treatment, Treatment of Industrial waste – Concept of CETP & Introduction to ETP, Design criteria of Industrial Effluent Treatment plant, Brief Introduction to cost analysis, Dis-infection treatment, Legal Aspects for Pollution Control – Statutory requirements, Regulations & Norms of GPCB

8 **Cleaner Technology**

Reuse & Recycle of waste water, Resources & Recovery, Environmental impact & assessment

9 **Solid Waste & Disposal Methods**

Sources & Classification, Methods of Disposal – Open Dumping, Sanitary Land filling, Incineration, Compositing

10 **Miscellaneous Pollution**

Noise Pollution, Biomedical waste, Radiation.

Practical / Term-work - Practical / term-work will consist of minimum ten experiments/ exercises based on above topics.

1CHA07 PETROLEUM REFINING & PETROCHEMICALS

L	T	P	C
3	-	2	4

1. **Origin, Formation & Composition of Petroleum**

Origin & formation of petroleum, Reserves & deposits of world, Indian petroleum industry: Oil exploration, Petroleum refining (Types, Location & Capacities), Composition of petroleum & Chemistry of petroleum

2. **Petroleum Processing Data**

Evaluation of petroleum, Properties of petroleum fractions(listing only), Listing of Distillation characteristic, Important products, properties & test methods: Gas, Gasoline, Jet fuel, Naphtha, Kerosene, Diesel fuel, Lube oil, Bitumen.

3. **Fractionation of Petroleum**

Dehydration & desalting of crudes, Heating of crude – pipe still heaters ;, Distillation of petroleum: Arrangement of tower, ADU &VDU Topping operation, Blending of gasoline: Line Blending , Gasoline Blending, Integrated refinery

4. **Treatment Techniques**

Fraction impurities Production and treatment of LPG: LNG technique, Amine treatment of LPG, Sweating operation for gas, Treatment of gasoline: Copper chloride process, Unisol process (with flow diagram),Duo-sol process, Dualayer (with flow diagram), Inhibitor sweating, Led doctoring of gasoline, Merox sweating, Treatment of kerosene:Sulfur dioxide extraction(Edeleanu Process), Treatment of lubes: Sulfuric acid treatment ,Clay treatment , Solvent treatment (with flow diagram), Purification of wax – Definition, Composition of paraffin wax, Old and new method of dewaxing (Brief Introduction), MEK Dewaxing, Propane Deasphalting, Wax Finishing

5. **Cracking**

Introduction and definition of Cracking, Thermal Cracking, Catalytic Cracking(with flow diagram), Catalytic reforming (with flow diagram), Naphtha cracking (with flow diagram), Cocking (with flow diagram), Hydrogen processes, Alkylation processes, Isomerizasion processes, Polymer gasoline

6. **Petrochemicals**

Definition, History, Major petrochemical products and their producers in India, Principal raw materials for petrochemicals

7. **Monomer from C_1 Compound**

Methanol (with flow diagram), Formaldehyde

8. **Monomer from C_2 Compound**

Ethylene (with flow diagram), Acetylene(only brief), Vinyl Chloride (with flow diagram), Ethanol (with flow diagram) and Acetaldehyde , Acetic acid

9. **Monomer from C_3 Compound**

Propylene (with flow diagram), Acetone & Cumene [Isopropyl benzene], Acrylonitrile, Acrylic Acid, M.M.A

10. **Monomer from C_4 Compound**

Butadiene (with flow diagram), Iso butylene, Butanol

11. **Aromatics Chemicals**

Benzene ,LAB (with flow diagram), Styrene, Toluene, Phenol, Benzaldihyde, Terephthalic acid & Dimethyle terephthalate(Brief), Phthalic anhydride & Malaic anhydride(Brief)

12. **Polymer compounds**

Polyethylene - LDPE, HDPE, LLDPE, HMDPE (with flow diagram).[ANY ONE], Polypropylene: Polyvinyl chloride (with flow diagram), Polyester, Polystyrene, PMMA (with flow diagram), Neoprin, PBR (with flow diagram), SBR

Practical / Term-work - Practical / term-work will consist of minimum ten experiments/ exercises based on above topics.

1CHA08 Fertilizer Technology

L	T	P	C
3	-	-	3

1 **Introduction**

Need of fertilizers, Types of fertilizers (straight, mixed / complex compound) (N,P,K), Merits & demerits of fertilizers, Natural fertilizer, Applications of fertilizers

2 **Nitrogenous fertilizers:**

Ammonia:- Sources Nitrogen and Hydrogen, Industrial Methods of obtaining Hydrogen, Nitrogen and Synthesis gas – Steam reforming of Natural Gas and Naptha, Partial Oxidation of RFO, Synthesis of Ammonia, study of various types of converters used for ammonia synthesis – Kellog Vertical quench converter, Ammonia Gasket converter with basket modification, Kellog Horizontal Ammonia Converter, Storage and handling of ammonia, Urea: Its properties, Urea as fertilizers – Process for manufacture of

Urea – Total recycle process, Stemi carbon stripping process (CO_2 stripping process), Snap progetti process (Ammonia stripping process), Nitric Acid:- Manufacture of Nitric acid by oxidation of Ammonia (high pressure, low pressure, medium pressure), Ammonium Nitrate:- Properties & manufacturing processes, Ammonium Sulfate:- Properties & manufacturing processes (from Gypsum, Direct Neutralization and by product Caprolactum)

3 Potassium Fertilizers

Roll of potassium in plant growth, Properties of Potash, Mining & refining of Potash, Other potassic fertilizers like potassium sulfate, potassium bisulfate – Potassium trisulfate, Potassium nitrate, Potassium hydroxide

4 Phosphatic Fertilizers

Types of rock phosphate, Their sources & composition, Mining of Phosphate rock, Phosphate rock processing, Super phosphates (Normal & triple), Phosphoric Acid – properties, application & manufacturing process(wet and hemi hydrate), Phosphates – Calcium meta phosphates, Diammonium phosphate, Nitrophosphate, Major Engg. Problem of different processes

5 Mixed Fertilizers

Manufacture & granulation of mixed fertilizers and bulk blending, Trace elements, other in gradient and micro nutrients

6 An introduction to Biofertilizer

7 Fertilizer Industry in India and its comparison with world's fertilizer Industry

Suggested Text / Reference Books

- George Austin ;"Shreev's Chemical Process Ind."
- M. Gopal Rao & M. Sitting ; "Dryden's Out line of Chemical Technoloty", E.W. Publication
- Industrial Chemistry by "B. K. Sharma"
- Handbook of Fertilizer Technology- M. G. Knor

Annexure - I
Advanced Technology Courses (Any Two)

Sr. No.	Course Code	Course Name	Teaching Scheme				Examination Scheme					
			Hours / Week			Credit	Hours		Examination Weightage			
			L	T	P		MSE	SEE	MSE	SEE	TA	LPW
1.	1CHD01	Dye-Intermediate Technology	3	-	-	3	1.5	3	0.25	0.60	0.15	-
2.	1CHD02	Dyestuff Technology	3	-	-	3	1.5	3	0.25	0.60	0.15	-
3.	1CHD03	Oil, Soaps & Detergents	3	-	-	3	1.5	3	0.25	0.60	0.15	-
4.	1CHD04	Bio-chemical Engineering	3	-	-	3	1.5	3	0.25	0.60	0.15	-
5.	1CHD06	Pharmaceutical Technology	3	-	-	3	1.5	3	0.25	0.60	0.15	-
6.	1CHD07	Agrochemicals	3	-	-	3	1.5	3	0.25	0.60	0.15	-
7.	1CHD08	Polymer Technology	3	-	-	3	1.5	3	0.25	0.60	0.15	-

1CHD01 DYE INTERMEDIATE TECHNOLOGY

L	T	P	C
3	-	-	3

1. **Introduction and classification of Dye-Intermediate**
2. **Basic principles of Unit Operation in Dye-Intermediate Technology**
   Sublimation, Freezing, Precipitation, Decantation, Filtration, Centrifugation, Size reduction and Size separation, Blending, Crystallization, Drying, Evaporation, Distillation, Extraction
3. **Material of Construction in manufacturing of Dye Intermediate**
4. **Unit Processes in manufacture of Dye Intermediate**
   Introduction, Chemical Reactions, Factors affecting on specific unit process, Technical Example of Nitration, Sulfonation, Alkylation, Amination by reduction, Amination by amonolysis, Helogenation, Brief Idea of following unit processes, Hydrolysis, Hydroxylation, Oxidation, Esterification, Hydrogenation
5. **Aliphatic Dye Intermediates (Manufacturing Process of any two)**
   Formaldehyde, Acetic anhydride, Acetic acid, Glycerin, Chloroacetic acid, Phosgene, Dimethyl Sulfate, Ethyl aceto Acetate, Ethylene, Ethylene Oxide
6. **Benzene Series**
   Raw material : Benzene, Structure , Physical Property and Handling, Nitro Benzene (m- dinitro Benzene), Aniline, Chlorobenzene and it's derivatives, P-Phenylene diamine (OPD, MPD), P- Nitro Aniline, Sulfanilic Acid (Orthanilic Acid, Metanilic Acid), PMP (1-Phenyl 2-Methyl 5-Pyrazolone), SPMP (1,4-Sulfo Phenyl 3-Methyl 5-Pyrazolone – Structure, Chemical reaction, Manufacturing process, Application
7. **Naphthalene Series**
   Raw Material : Napthalene, Structure , Physical Property and Handling, NW acid, α- Nepthylamine, Sodium Napthionate, G-salt, Schaffer's Acid, Tobias Acid, γ- Acid, H-Acid, K-Acid – Structure, Chemical reaction, Manufacturing process, Application
8. **Hetrocyclic Dye Intermediate**
   Cynuric Chloride, Pyridine, Quinaldine – Structure, Reactivity, Handling, Manufacturing process, Application
9. **Anthracene Series**
   Raw Material : Anthracene, Structure , Physical Property and Handling, Anthraquinone, Benzanthrone, 1-Amino AQ & 2-Amino AQ, AQ 1-Sulfonic acid , AQ 2-Sulfonic acid, Qunizarine, Anthraquinone disulfonic acid (1,5 and 1,8), Dichloro derivative of anthraquinone (1,5 and 1,8), Anthrarufin (1,5 dihydroxy AQ), Chrysazine (1,8 dihydroxy AQ) – Structure, Chemical reaction, Flow diagram, Manufacturing process, Application

1CHD02 DYE STUFF TECHNOLOGY

L	T	P	C
3	-	-	3

1 **Introduction and classification of Dyes**
   Raw materials/Basic chemicals in manufacture of Dyes and their testing methods – Nitrite Value, Melting Point, Coupling Value, Hydrolysis Value, Purity Tests, Color Chemistry – Absorption Spectra
2 **Unit Operations involved in manufacturing of dyes**
   Spray drying and Tray drying, Filtration, Size reduction – Sand milling, Pulverizing, Ball mill, Blending
3 **Basic principles of Unit Processes involved in manufacturing of Dyestuff**
   Diazotization, Cynurization, Coupling, Isolation
4 **Application of Dyes**
   Types of Fiber, Dyeing Methods, Fastness Properties of dyestuff – Washing Fastness, Light Fastness, Degree of staining
5 **Effluent Treatment methods in Dye-Industries**
   Physical methods, Chemical methods, Biological methods
6 **Pigments**

Classification of Pigments – Organic Pigments, Inorganic Pigments, Manufacturing Processes – CPC Green, CPC Blue, Structural formula of various Pigments, Uses of Pigments

7 Reactive Dyes

Introduction and types of reactive groups, Manufacturing Processes of – Reactive Black B, Turquoise Blue H5G, Reactive Red M5B, Direct Dyes – Introduction, Manufacturing Processes of – Direct Black 22, Direct Black E, Congo Red, Food Colors – Introduction, Manufacturing Processes of – Acid Yellow 3, Tetrazine Yellow

8 Vat Dyes

Introduction, Manufacturing Processes of – Vat Green FFB, Indigo, Indanthrene Blue RS, Disperse Dyes – Introduction and Classification, Manufacturing Processes (one example of) – Monoazo type, Diazo type, Anthraquinone based

9 Basic Dyes

Introduction , Manufacturing Processes – Rhodamine, Methylene Blue, Acid Dyes and Solvent Dyes – Introduction, Manufacturing Processes – Acid Blue 45, Acid Green 25, Acid Green 27, Acid Black 210, Acid Flouroscine., Application of Dyes to various types of fibers

1CHD03 OIL, SOAP & DETERGENTS

L	T	P	C
3	-	-	3

1. Oil Essentials, Composition & Classification

2. Manufacturing of Oils:

Edible Oil: Ground nut, Soyabean, Mustard, Seed, Sunflower, Cottonseed oil, Non-edible Oil: Caster seed, Neem Oil etc, Essential Oils in brief: Rose, Lemon, Sandlewood etc.

3. Soap Raw Materials Selection and their Processing

4. Soap Solution - Phase Properties:

Binary: Soap-water system, Ternary: Soap-water-salt system

5. Commercial Processing

Direct Saponification: Batch Process, Continues Process, Natural oil saponification and Glycerine Recovery, Fatty Acid Neutralisation & byproduct

6. Manufacuring of Soap:

Framming. Milling, IIot Extrusion Technology

7. Formulation of Soap

Soap Bars, Bar-Soap, Additives: Free Fatty Acid, Colorants, Dyes, Pigments, Fragnance, Chelants & Antioxidents, Liquid Soap & body washes

8. Formulation & Components of Detergents

Subtrates, Soils, Surfactants, Builders, Inorganic & Organic Additives and enzimes.

9. Factors Affecting Detergency

Effect of Surfactants Cone., Surfactants Structure, Water Hardness and Builder, Antiredeposition Agent, Liquid Soil, Solid soil type and size, Temperature & machanical action, foam etc.

10. Measurement of Detergency

Fabric Detergency, Hard surface Detergency

11. Manufacturing of Detergents

Liquid products, Spray-Dried products, Dry-Blended products, Agglomerated products, Speciality detergents

12. Safety & Environment Considerations for Detergent Industry

1CHD04 BIO-CHEMICAL ENGINEERING

L	T	P	C
3	-	-	3

1 Introduction To Bio- Chemical Engineering

Future Scope and Opportunities

2 **Classification & Characteristics of Biological matters**
Prokaryotic Organisms: Bacteria & Blue- Green Algae, Eukaryotic Organisms: Fungi, Algae, Moulds & Protozoa, Animal & Plant Cell

3 **Chemical Composition of Cells (Introductory Only)**
Lipids, Sugars & Polysaccharides, Nucleotides, to RNA and DNA, Amino acids in to Proteins

4 **Enzyme – Catalysis**
Action of Enzymes, Introduction to – Modulation and Regulation of Enzymatic Activity, Enzyme Deactivation, Application of Enzyme Catalysis: Hydrolysis of Starch and Cellulose, Protelytic Enzymes, Esterase applications, Medical applications of Enzymes, Non- Hydrolytic Enzymes in Industrial Technology, Immomobilized- Enzyme Technology.

5 **Microbial Growth**
Monod Growth Model, Factors affecting Microbial Growth, Introduction to Bio- Degradation

6 **Biological Reactors**
Sterilization Reactors: Batch Sterilization, Continuous Sterilization, Fermentation Technology: Medium formulation, Operation of a Typical Fermentation Process, Animal & Plant Cell reactor Technology: Environmental Requirements for Animal cell Cultivation, Reactors for large –Scale Production using animal cells, Environmental Requirements for plant cell cultivation

7 **Product Recovery Operations:**
Recovery of cell and solid particles: Filtration, Centrifugation, and Sedimentation, Product isolation: Extraction, Sorption, Precipitation, Membrane Separations: Reverse Osmosis, Ultrafiltration, Micron & micron filtration, Electrophoresis

8 **Bio Process Economics**
Process Economics, BioProduct Regulation, General Fermentation Process Economics

9 **Some important Bio Chemicals**
Fine Chemicals: Enzymes, Proteins, Antibiotics,Vitamins,Alkaloids,Nucleosides,Steroids,Monoclonal Antibodies (MAB) , Bulk Oxygenates, Single cell protein(SCP), Anaerobic Methane production

10 **Introduction to Molecular Genetics**
Strain improvement methods, Recombinant DNA, Mutations

1CHD06 PHARMACEUTICAL TECHNOLOGY

L	T	P	C
3	-	-	3

1. **Introduction**
Introduction, History, Indian scenario – Major Manufacturers and its classified activities in pharmaceutical field.

2. **Unit Processes**
Condensation Process, Esterification Process, Alkylation Process, Carboxylation Process, Acetylation Process, Dehydration Process, Sulfonation and sulfanation, Hydrogenation Process, Nitration Process, Oxidation Process, Amination by Reduction, Halogenation, Hydrolysis, Fermentation.

3. **Pharmaceutical Classification and Generalized manufacturing process flow diagrams.**
Antibiotic drugs, Cardiovascular Drugs, Drugs acting on Central Nervous System, Chematherapetic Drugs, Sulfa Drugs, antidepressants, Tranquilizers, Hypnotics, Sedatives and Anticonvulsants, Analgesic and Antipyretics, Vitamins.

4. **Generalized manufacturing process flow diagrams of the following dosage forms**
Tablets (Granules and pellets), Capsules (Hard and Soft), Liquids (Orals), Injectable, Ointment & Cream, Aerosol.

5. **Packaging principles of the above dosage forms (as per Sr. no. 4)**

6. **Equipments and machineries**
Equipments, machineries and their operations for sr. no. 4 & 5.

7. **Statuary requirement for the Pharmaceutical Industries, schedule M (GMP)**

8. **Service required like Steam, Gases, Water (R. O., Potable, D. M., Distilled, water for injection,**

Chilled water, cooling water, raw water) Air, Vacuum, ventilation system (Classification only)

1CHD07 AGROCHEMICALS

L	T	P	C
3	-	-	3

1. **General Introduction**
   Historical background, Present Scenario – Domestic and international, Brief on pest – disease – crops – soils, etc., Economics, Adverse nature of the chemicals, integrated pest management.
2. **Classification of Pesticides**
   Based on action: Insecticides, herbicides, fungicides, etc, Based on chemical structure: Organophosphorous, organohalogen, pyrethroids, Carbamate, Urea based etc., Route: Systemic and local.
3. **Pesticides – Chemistry and Technology**
   Classification: Organophosphorous, Organohalogen, Synthetic pyrothoides, Carbamte [One example of each and chemical reaction (not in all detail reactions)], Nature of preparation for each class – Building blocks for preparation, Flow charts [Critical steps for preparation including unit operation]
4. **Formulation, Technology, Delivery Systems and Application (Past, Present and Future) with Equipment used, Characteristics and Applications of the following:**
   WP (Wettable powder), Dust, EC (Emulsifyable concentrate), SC (Suspension Concentrate), ULV (Ultra Low Volume), WG (Wettable Granules), Granules, Micro Emulsion
5. **Quality Control**
   Quality control of active ingredients – Instrumental Analysis, Classical methods, Other methods, Quality Control of formulated products – Active ingredients, Stability test, Quality control of packaging
6. **Toxicity**
   Health and safety at manufacture level and at storage, Environmental, Residues in human body
7. **Natural Pesticides**
   Biopest: Neem, Karanja, Chillies, Garlic, etc.
8. **Regulatory**
   Registration of active ingredient and formulation (CIB – Center Insecticides Board and Insecticide Act), Manufacture license from local agricultural department etc.

1CHD08 POLYMER TECHNOLOGY

L	T	P	C
3	-	-	3

1. **The genesis of polymers**
   Brief history, About polymers, Classification of polymers
2. **Polymerisation Methods**
   Introduction, Chain polymerisation – Free radical polymerisation, Ionic polymerisation, Introduction to catalytic polymerisation, Step polymerization
3. **Polymerisation Techniques**
   Bulk polymerisation, Solution polymerisation, Suspension polymerisation, Emulsion polymerisation, Melt polycondensation, Solution Polycondensation
4. **Chemical and geometrical structure of polymer molecules**
   General remarks on polymer microstructure, Microstructure based on the chemical structure – Organic and inorganic polymers, Homochain and heterochain polymers, Homopolymers and copolymers, Microstructure based on the geometrical structure – Linear, branched and cross-linked polymers, Random, alternating, block and graft co-polymers, Stereo-regular polymers – Optical isomerism, Geometrical isomerism
5. **Introduction to following topics**
   Polymer blends and polymer composites, Glass transition temperature
6. **Plastics**

Introduction, Classification of Plastics, Raw Materials, Manufacturing Processes for the Addition Polymerization Products like Poly Ethylene, LDPE, HDPE, PVC, Poly Styrene, Alloying and blending of polymers, Engineering Plastics like Nylon, ABS, Poly Carbonates, TEFLON etc, Recent trends in plastics like bio degradable plastics etc., Industrial application of above polymer

7. Rubbers

Introduction and classification of rubber, Natural rubber, Manufacturing Processes of synthetic rubbers like SBR, Poly Butadiene, Poly Ethylene- Propylene & Butyl Rubber, Brief of some important rubber like Nitrile rubber , Neoprene, Reclaim Rubber, Industrial application of above polymer

8. Resins for Adhesives and Protective Coating

Introduction, Condensation polymerization products like Phenol Formaldehyde (Phenolic Resins), Amino Resins, Poly Ester Resins, Alkyl Resins and Epoxy Resins, Poly Urethane Resins, Poly Amide Resins, Addition Polymerization Products like Vinyl Resins, Vinyl Alcohol Resins, Vinylidine Resins, Styrene Resins and Acrylic Resins, Protective Coatings

9. Fiber and Film

Introduction to fiber and the overall textile industry, Properties of fiber, Cellulosic fiber: Viscose Rayon and Cellulose Acetate, Polyamide fibers, Polyester fiber, Acrylic fibers, Inorganic fibers like glass, carbon etc, Films: Viscose & Cellulose Acetate, Poly olefins, Poly Vinyl Chloride