



DIPLOMA SYLLABUS

Department of Chemical Engineering



Faculty of Technology

Dharmsinh Desai University, Nadiad – 387 001,
Gujarat, India.

(2025-2026)

<https://www.ddu.ac.in>

TEACHING SCHEME FOR THE COURSE DEPLOMA

CHEMICAL ENGINEERING

L – Lecture

T – Tutorial

P – Practical

Th. – Theory

Ext - External

S – Sessional

TW – Term Work

Teaching Scheme – hr/week

SEMESTER-I

Subject	Teaching Scheme (hrs/week)			Total	Credit	Examination Scheme				
	L	T	P			hr	Th.	S	P	TW
Mathematics – I	3	1	0	4	4	60	40	-	-	100
Communication Skill	3	0	0	3	3	60	40	-	-	100
Applied Chemistry	4	0	2	6	5	60	40	50	25	175
Engineering Graphics	2	1	3	6	4.5	60	40	50	25	75
Engineering Measurement	0	0	2	2	1	-	-	50	25	75
Computer Application	0	0	3	3	1.5	-	-	50	25	75
Total	12	2	10	24	19	240	160	200	100	700

SEMESTER-II

Subject	Teaching Scheme (hrs/week)			Total	Credit	Examination Scheme				
	L	T	P			hr	Th.	S	P	TW
Mathematics – II	3	1	0	4	4	60	40	-	-	100
Organic Chemistry	4	0	3	7	5.5	60	40	50	25	175
Physical Chemistry	4	0	3	7	5.5	60	40	50	25	175
Chemical Engineering Material	3	0	0	3	3	60	40	-	-	100
Elements of Mechanical And Electrical Engineering	3	0	0	3	3	60	40	-	-	100
Work Shop	0	0	2	2	1	-	-	-	50	50
Total	17	1	8	26	22	300	200	100	100	700

SEMESTER-III

Subject	Teaching Scheme (hrs/week)			Total hr	Credit	Examination Scheme				
	L	T	P			Th.	S	P	TW	Total
Mechanical Operations	4	0	3	7	5.5	60	40	50	25	175
Chemical Process Industries	3	0	2	5	4	60	40	50	25	175
Industrial Safety & Environmental Engineering	3	0	2	5	4	60	40	50	25	175
Plant Utility & Energy Engineering	3	0	0	3	3	60	40	-	-	100
Plant Design, Management & Economics	3	0	0	3	3	60	40	-	-	100
IKS & Yoga	1	0	2	3	2	-	-	50	-	50
Total	17	0	9	26	21.5	300	200	200	75	775

SEMESTER-IV

Subject	Teaching Scheme (hrs/week)			Total hr	Credit	Examination Scheme				
	L	T	P			Th.	S	P	TW	Total
Heat Transfer	4	0	3	7	5.5	60	40	50	25	175
Fluid Flow Operations	4	0	3	7	5.5	60	40	50	25	175
Process Calculations	3	1	0	4	4	60	40	-	-	100
Mass Transfer-I	4	0	3	7	5.5	60	40	50	25	175
Instrumentation	3	0	0	3	3	60	40	-	-	100
Chemical Engineering Equipment Drawing	0	0	3	3	1.5	-	-	50	25	75
Total	18	1	12	31	25	300	200	200	100	800

SEMESTER-V

Subject	Teaching Scheme (hrs/week)			Total hr	Credit	Examination Scheme				
	L	T	P			Th.	S	P	TW	Total
Mass Transfer – II	4	0	3	7	5.5	60	40	50	25	175
Elements of Thermodynamics & Reaction Engg	3	1	0	4	4	60	40	-	-	100
Petroleum Refining & Petrochemical Technology	3	0	2	5	4	60	40	50	25	175
Fertilizer Technology	3	0	2	5	4	60	40	50	25	175
Polymer Technology	4	0	0	4	4	60	40	-	-	100
Total	17	1	7	25	21.5	300	200	150	75	725

SEMESTER-VI

Subject	Teaching Scheme (hrs/week)			Total hr	Credit	Examination Scheme				
	L	T	P			Th.	S	P	TW	Total
Industrial Training/Projects	0	0	30	30	15	-	-	100	50	150
Seminar	0	0	6	6	3	-	-	-	50	50
Total	0	0	36	36	18	0	0	100	100	200

SEMESTER-I

Subject	Teaching Scheme (hrs/week)			Total hr	Credit	Examination Scheme				
	L	T	P			Th.	S	P	TW	Total
Mathematics – I	3	1	0	4	4	60	40	-	-	100
Communication Skill	3	0	0	3	3	60	40	-	-	100
Applied Chemistry	4	0	2	6	5	60	40	50	25	175
Engineering Graphics	2	1	3	6	4.5	60	40	50	25	175
Engineering Measurement	0	0	2	2	1	-	-	50	25	75
Computer Application	0	0	3	3	1.5	-	-	50	25	75
Total	12	2	10	24	19	240	160	200	100	700

DIPLOMA SEMESTER – I
SUBJECT: MATHEMATICS-I (23DK-101)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	1	0	4	60	40	-	-	100

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of Mathematics. Students will learn to solve different kinds of problems in different aspects of Mathematics with its application, problem solving knowledge.

B. COURSE CONTENT

NO	TOPIC	L+T (Hrs)	COs
[1]	Concept and Rules, Examples on indices, Definition and concept, Simple examples on surds, Square root of Surds, Examples on square root of Surds, Definition and concept, Logarithms rules, Examples based on rules and calculations, Formula for nth term of an A.P., Sum of n terms of an A.P., Definition of Arithmetic mean, Definition, Computation of nth term of a G.P, Sum of n term of G.P., Definition of geometrical mean, Examples, Formula for $r + 1$ term of $(x + a)^n$.	15	C01 C02 C03
[2]	Examples of finding any term of middle term of $(x + a)^n$, Finding constant term and coefficient of $(x)^r$, Examples of $(1 + x)^n$. Introduction and Types of Matrices, Algebra of Matrices, Adjoint and Transpose of matrices, Inverse of a matrix, Solution of simultaneous linear equation by matrix method, Definition of a vector, scalar and Types of vectors.	10	C03 C04
[3]	Geometric representation of vector, Addition and Subtraction, Unit vectors, Magnitude and Direction of vector, Product of vector and scalar, Dot product and Cross [product of two vectors. Concept of Angles. Degree and Radians, Area of sector and arc-length.	06	C03 C04
[4]	Concept of allied angles, Definition and concept of periodic function, Graphs of Sine and Cosine, Concept of addition and Subtraction formula, Sum and difference formula, Formula for 2A and 3A and their multiples.	10	C05 C06
[5]	Definition and concept, Product formulae, A/2 formulae, simple examples, Sine and cosine rules, Projection formulae, solution of triangle using formulae, Inverse trigonometric function definition and examples, Height and Distance and examples.	10	C05 C06

C. TEXT BOOKS

1. Dr. N. R. Pandya. *Polytechnic Mathematics – I*. Mahajan publishing house, Ahmedabad.

D. REFERENCE BOOKS

1. Prof. R. P. Rethaliya. . *Polytechnic Mathematics – I*. Nirav and Roopal prakashan, Ahmedabad.
2. B. M. Patel, Dr. Ajay V. Shah, Mehul B. Patel. *Diploma Engineering Mathematics –I*. Nirali prakashan, Mumbai.

E. COURSE OUTCOMES

COs	Statement
CO1	Understand effective mathematical rules and definition for the concept of indices, surds.
CO2	Understanding rules of logarithm and Extend the concept learning of Arithmetic Progression and Geometric Progression and examples.
CO3	Analyse and evaluate binomial expansion and understand to get middle and constant term of expansion.
CO4	To understanding how to derive the solution of addition or multiplication of Matrices with examples and understand the types of the matrices and to get solution of equation by matrix and discuss vectors.
CO5	Evaluate and Differentiate Measurement of angles, Trigonometric ratios, allied angles compound angles and to sketch the graph of periodic function.
CO6	Able to Investigate Inverse Trigonometric function, Properties of triangle and solution of triangle and measure, height and distance and examples.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	2	2	2	1	1	1	1	3	3
CO2	3	3	2	2	2	2	2	2	2	1	2	3	3
CO3	3	3	3	2	3	3	2	2	2	3	2	3	3
CO4	3	3	3	3	3	3	2	2	2	3	3	3	3
CO5	3	2	3	3	2	2	2	2	2	2	2	3	3
CO6	3	3	3	2	2	2	2	2	3	2	2	3	3
Avg	2.8	2.7	2.7	2.8	2.3	2.3	2.3	2	1.8	2	2	3	3

DIPLOMA SEMESTER – I
SUBJECT: COMMUNICATION SKILLS (23DK-103)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	0	0	3	60	40	-	-	100

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of good writing skills as well as speaking. Students will learn how to have discussion, letter writing, IPA, importance of speaking at a workplace, technical communication and its importance. Students will improve their intellectuality through classroom discussion and can polish their grammatical mistakes through the grammatical exercises held in the classroom.

B. COURSE CONTENT

NO	TOPIC	L+T (Hrs)	COs
[1]	Basics of Communication: Introduction, the process of communication, importance of communication at a workplace, Language a tool of communication, level of communication, upward and downward communication, the flows of communication, communication Networks, the importance of technical communication.	10	C01 C02 C03 C04
[2]	Barriers to communication: definitions of noise/barrier to effective communication, Classification of the barrier to effective communication: Intrapersonal, interpersonal and Organisational. Verbal and non-verbal communication and its advantages and drawbacks. Letter writing: introduction, types, formats, business letter writing, types, purposes: request, complaint, order, congratulation, sales quotation etc. Exercises.	08	C01 C02 C05
[3]	Grammar: Sentence structure, clauses: Definite and indefinite, nouns, pronouns. Articles: A, An, and The; definite and indefinite differentiations between the grammatical terminologies like articles, clauses and nouns. Paragraph development, techniques of development. Exercises	06	C01 C02 C03 C05
[4]	Oral Forms: Active listening: Introduction, types of listening, traits of a good listener, Active versus Passive listening, Six stages of Listening, implications of Effective listening. Group Discussion: Objectives, introduction, group discussion, organizational Group Discussion, Group Discussion as a part of Selection Process, Meetings, Conferences. Practical: classroom discussion. Exercises.	13	C01 C02 C03 C06
[5]	Presentation: Introduction, types of presentation, importance of presentation, importance of business presentations. Effective presentation strategies: defining purposes, Analysing audience and locale, organizing content, preparing an outline, visual aids, and nonverbal elements: Kinesics, Proxemics, Haptics, Artifacts, paralinguistics. Practical exam: presentation and Exercises. IPA: The Phoneme, the Syllable. The sounds of English: Vowels, the production of speech, description of sounds.	11	C01 C02 C03 C06

C. TEXT BOOKS

1. Shoba KN, Sam Praveen. *Technical English: A Work book*. Cambridge University Press. 2019.

D. REFERENCE BOOKS

1. Raman Meenakshi, Sharma Sangeeta. *Technical Communication: principles and Practice*. Oxford University Press. 2007.

E. COURSE OUTCOMES

COs	Statement
CO1	To understanding the methodology of communication.
CO2	To understand the barriers and flows of communication, interconnection of the flow, the basic of writing technical, purposes of writing letters. To develop efficiency in writing.
CO3	Understand the vocabulary and their root forms to enhance vocabulary level. Grammatical tests, to rectify their mistakes/errors while writing and speaking.
CO4	Rectify common errors in their speaking and writing, Acquire proficiency in all four skills of language.
CO5	Be competent at a public speaking and Interviews.
CO6	To deconstruct the challenges of delivering effective presentation, to develop strategies to make effective presentations.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	2	3	3	2	2	2	3	3	3	3
CO2	3	3	3	3	2	2	3	3	2	3	3	3	3
CO3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	2	3	3	3	3	3	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3	3	3
CO6	3	2	3	3	3	3	3	3	3	3	3	3	3
Avg	3	2.6	2.8	2.8	2.8	2.8	3	2.8	2.6	3	3	3	3

DIPLOMA SEMESTER – I
SUBJECT: APPLIED CHEMISTRY (23DK-102)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
4	0	2	5	60	40	25	50	175

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of Applied Chemistry. Students will learn about some very basic concept of chemistry, fundamentals of atomic structures, electronic configuration, properties and periodic trends of elements, bonding in molecules, chemical and ionic equilibrium, solution and its properties and also water and its treatments with its industrial application, problem solving knowledge and different types of problem and its solution that are used for future higher studies and in industries as well.

B. COURSE CONTENT

NO	TOPIC	L+T (Hrs)	COs
[1]	Basic Concept: - Matter, elements, compounds, atoms, molecules, molecular formula, mole concept, vogadro's number, gram-atomic weight, gram-molecular weight, equivalent weight, STP, Avogadro's hypothesis and its application, derivation of general gas equation $PV=nRT$, Dalton's law of partial pressure	6	CO1 CO2
[2]	Atomic structure: - Thomson's model its limitation, Rutherford's model and its limitation, Brief introduction to Bohr's model and its limitation, Concept of shells and subshells, Dual nature of matter and light, De-broglie relationship, Heisenberg uncertainty principle, Modern concept of atomic structure, atomic number, mass number, orbital concept, quantum numbers, shape of orbital, electron configuration of elements using Auf-bau principle, Hund's rule and Pauli's exclusion principle, isotopes, isobars.	7	CO1 CO3
[3]	Modern periodic table: - Brief introduction to Mandeleev's periodic table and its drawback, Classification of element on the basis of their electronic configuration, periodic trend of ionization energy, electron affinity and electron negativity of elements in periodic table	6	CO1 CO4
[4]	Chemical Bonding: - Ionic bonds, co-valent bonds, co-ordinate co-valent bonds, H-bonds, valence, electronic theory of valence, Dot & Lewis formula of elements, Valence bond theory(VBT) and geometry of some simple molecules having hybridization of sp^3 , sp^2 , sp , Valence shell electron repulsion pair theory(VSEPR) with shape of some simple molecules like BeF_2 , BF_3 , CH_4 , PCl_5 , Molecular Orbital Theory(MOT) of homo nuclear diatomic molecules like H_2 , He_2 , O_2 , N_2 .	6	CO1 CO3
[5]	Chemical equilibrium: - Reversible & irreversible reaction, rate of reaction, law of mass action, equilibrium state, equilibrium constant K_e for homogeneous and heterogeneous systems, relationship between K_e and K_p , Le-Chatelier principle and its application	6	CO1 CO5
[6]	Ionic equilibrium: - Ionization of strong and weak electrolytes in water, ionic equilibrium, acid and base theories, dissociation constant of weak acid, K_a , weak base K_b and K_{sp} Self-ionization of water K_w , pH scale, determination of pH of solution from its strength, buffer solutions, Common ion effect with illustrative example	6	CO1 CO5
[7]	Solutions: - Types of solutions, different methods of expressing	5	CO1

	strength of solutions, viz. molarity, molality, normality, formality, weight percent, preparation of standard solutions, Vapour pressure and Rault's law, ideal and non-ideal solution, positive and negative deviation of non-ideal solution from Rault's law		CO2
[8]	Water and its treatment: - Sources of water, hard and soft water, kinds of hardness, effect of hardness, removal of hardness of water by soda-lime, permutite and ion-exchange process.	6	CO1 CO6

C. PRACTICAL AND TERM WORK

1. Introduction of various laboratory apparatus
2. To determine the normality and gms/lit of given XN H₂SO₄ solution using 0.3N NaOH solution
3. To determine the normality of gms/lit of given XN NaOH solution using 0.4N HNO₃ Solution
4. To determine the normality and gms/lit of given 0.5N CH₃COOH solution using XN NaOH solution
5. To prepare and standardize 0.4N HCl using 0.4N Na₂CO₃ solution
6. To prepare and standardize 0.3 N KOH using 0.3N Oxalic Acid Solution
7. To determine amount of Mg⁺² metal using 0.01 M EDTA solution and EBT as an indicator
8. To find out the total hardness of tap water using EDTA method.
9. To find out the percentage purity of a given sample of iron
10. To find out the percentage of a given sample of copper iodometrically

D. TEXT BOOKS

1. Arun Bahl, B.S. Bahl, G.D. Tuli, *Essential of Physical chemistry*. New Delhi: S.Chand publication; 2009.

E. REFERENCE BOOKS

1. David E Goldberg., *Chemistry foundation*. New york McGraw-Hill ; 1991
2. Brown, Theodore Lemay, H Eugene, *Chemistry: the central science*, N.J. PHI; 1985
3. Dr. A. S. Patel, Dr. K. M. Shah, *Applied Science I : Chemistry*, Ahemedabad, Atul Prakashan; 2000
4. V.P.Mehta., *Polytechnique chemistry*, New Delhi, Jain Brothers; 2017

F. COURSE OUTCOMES

COs	Statement
CO1	Acquire knowledge of different basic terms included in chemistry like atomic structure, periodic properties, chemical bonding, equilibrium and water hardness treatment etc.
CO2	Relate the formula of mass, moles, atoms, molecules & different way of expressing concentration of the solution & their preparation.
CO3	Acquire the knowledge of various models of atomic structure, principles of electronic configuration and hybridization & its theories.
CO4	Identify a period & group on the periodic table as well as compare the periodic properties of elements.
CO5	Understand & explain the essential aspects of chemical as well as ionic equilibrium & get knowledge of basic acid base concepts.
CO6	Get the idea about type of water sample & its treatments.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	3	2	2	3	2	3	3	3
CO2	3	3	3	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3
CO6	3	2	3	3	3	3	3	3	3	3	3	3	3
Avg	3	2.5	2.8	2.8	2.8	2.8	3	2.8	2.5	2.8	3	3	3

DIPLOMA SEMESTER – I
SUBJECT: ENGINEERING GRAPHICS (25DK115)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
2	1	3	4.5	60	40	25	50	175

A. COURSE OVERVIEW

The objective for this course is to learn about various aspects of Technical Drawing. To learn and make use of the use of drawing equipments. The aspects of Orthographic Projection and Isometric projection are very useful in industries to have understanding of size, shape and geometry of any object. To understand various machine parts, Graphs and Charts used in day to day life and industries.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction: - Drawing equipments, material & their uses, Planning & Layouts of the Drawing Lines, Letters and dimensioning Plane geometrical drawing: Simple geometrical construction such as construction of plain figure, drawing of arcs and other construction.	03	CO1 CO3
[2]	Plane Geometry: - Construction of curves used in engineering such as Conics (Ellipse, Parabola, Hyperbol) Cycloidal curves (Cycloid, Epi-cycloid, Hypocycloid) Involutés, Archimedean spirals.	09	CO1 CO4
[3]	Solid Geometry :- Projection of points, Projection of lines (without H.P & V.P), Projection of planes, Projection of right and regular solids (Prism, Pyramids, Cylinder and Cones)	12	CO1 CO4 CO6
[4]	Orthographic Projection: - Conversion of pictorial views into orthographic views,	05	CO2 CO3 CO4
[5]	Isometric projection: - Various Projection methods, First angle method of projection, Third angle method of projection, Rules for dimensioning, Conversion of pictorial view into orthographic views.	05	CO1 CO5
[6]	Sectional Orthographic Projection: - Conversion of pictorial views into orthographic projection with section type of sections-Full section, Half section, interpretation of orthographic views.	04	CO1 CO5 CO6
[7]	Machine parts: - Types of threads, Bolts & Nuts, Locking devices for Nuts Rod connections (cotter joints & knuckle joint, shaft couplings, bearings, welded joints.	03	CO1 CO3
[8]	Graphs and Charts: - Concept of representation of data on graphs & Charts	02	CO2 CO3

C. TEXT BOOKS

1. Elementary Engineering Drawing by N.D.Bhatt,
2. Engineering Graphics by P.J.Shah

D. REFERENCE BOOKS

1. Machine Drawing by P.S.Gill

E. COURSE OUTCOMES

COs	Statement
CO1	The general introductions and concept of Engineering Drawing.
CO2	To choose appropriate devices for any given conditions.
CO3	To apply basic concepts of drawing in industrial devices.
CO4	To understand the importance of technical drawing
CO5	Types of drawings used in industries.
CO6	To Understand basic methods of drawing.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	3	3	3	2	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	3	3	3	2	3	3	3	3
CO6	3	3	3	3	2	3	3	3	2	3	3	3	3
Avg	3	2.6	2.5	2.6	2.5	3	3	3	2.5	3	3	3	3

DIPLOMA SEMESTER – I
SUBJECT: ENGINEERING MEASUREMENTS (23DK111)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
0	0	2	1	-	-	25	50	75

A. COURSE CONTENT

NO	TOPIC
[1]	Introduction to Physical Quantities and Units
[2]	Linear Measurements: - Length & Diameter by Scale, inside- outside calipers
[3]	Precision Measurements: - Length & Diameter by Vernier calipers, Micrometer screw, Depth gauge
[4]	Measurement of Area Regular & Irregular shapes
[5]	Measurement of Electrical Energy
[6]	Measurement of frictional coefficient
[7]	Measurement of volumetric flow rate & Mass flow rate
[8]	Measurement of pH
[9]	Measurement of hardness of water
[10]	Measurement of Specific Gravity
[11]	Measurement of Viscosity

Sr.No.1 to 6 will be conducted by Mech. Engg. Department while rest will be by Chemistry department.

DIPLOMA SEMESTER – I
SUBJECT: COMPUTER APPLICATION (23DK-109)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
0	0	3	1.5	-	-	25	50	75

A. COURSE OVERVIEW

The course is introducing general knowledge of computer, computer system and Microsoft office. In Microsoft office students try to understand how to work in word file, excel sheet, power point presentation and application of this system for different section. Also understanding of Stander formatting of different files, windows version and basic operation with short cuts.

B. COURSE CONTENT

NO	TOPIC
[1]	Introduction to computer system and software
[2]	Introduction to operating system, file identification, bytes, directory
[3]	Introduction to word processing, data entry, save, quit.
[4]	Basic setting like left and right margin, footnotes, headers, justification, tabulation
[5]	Editing text using detailing character, word lime, search, replace directory
[6]	Cut\paste, move, copy, sort, file read, file write
[7]	Mail merge, print, index, book mark, tables of content
[8]	Introduction to worksheet, workbook, cell, row, column, data entry, open, save, quit, help
[9]	Editing data, clean, insert, delete cell, row, column
[10]	Work sheet settings, width of column, color, heading, wide and display, align data, bold, italics, orientation
[11]	Freeze rows, columns split sort, legend
[12]	Multiple worksheets, copy, move, linking data between worksheets
[13]	Prepare worksheet to print, page break
[14]	Discipline wise Engineering Application

SEMESTER-II

Subject	Teaching Scheme (hrs/week)			Total hr	Credit	Examination Scheme				
	L	T	P			Th.	S	P	TW	Total
Mathematics – II	3	1	0	4	4	60	40	-	-	100
Organic Chemistry	4	0	3	7	5.5	60	40	50	25	175
Physical Chemistry	4	0	3	7	5.5	60	40	50	25	175
Chemical Engineering Material	3	0	0	3	3	60	40	-	-	100
Elements of Mechanical And Electrical Engineering	3	0	0	3	3	60	40	-	-	100
Work Shop	0	0	2	2	1	-	-	-	50	50
Total	17	1	8	26	22	300	200	100	100	700

DIPLOMA SEMESTER – II
SUBJECT: MATHEMATICS-II (23DK-201)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	1	0	4	60	40	-	-	100

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of Mathematics. Students will learn to solve different kinds of problems in different aspects of Mathematics with its application, problem solving knowledge.

B. COURSE CONTENT

NO	TOPIC	L+T (Hrs)	COs
[1]	Concept and Rules of Point: - Distance formula, circum centre and in centre of triangle, Examples based on distance formula, Area of triangle, Examples of Area of Triangle, Concept of division of line segment. Internal and External Division, Examples of division of line segment, Locus of point concept and definition and examples, Different types of equation of straight line, slope, intercepts.	15	CO1
[2]	Straight Line: - Equation of straight line passing through two points or slope and one point, Parallel and perpendicular straight lines, and Examples, Angle between two lines and examples, Circle: - Definition, Equations of circle and examples, Tangent and normal to the circle.	10	CO2 CO3
[3]	Function and limit: - Definition, Types of Functions. One one, onto function, Concept and rules, examples, Differentiation: Concept Definition, Basic Examples by definition, Formula for x^n , $\sin x$, $\cos x$ etc, Examples based on formulae.	06	CO4 CO5
[4]	Definition and concept of Differentiation: - Rules for addition, subtraction, product and division of functions, Examples based on rules, Chain rule and Examples, Derivation of parametric and implicit functions and Examples, Higher order differentiation, Application of derivative (velocity, acceleration, maxima-minima), Examples.	10	CO5 CO6
[5]	Definition and concept of Integration: - simple basic rules, Formulae of integration, Example based on formula, Indefinite and definite integrals, Examples, Integration by parts, Method of Substitution, Application of integration. (Area, volume) and examples.	10	CO5 CO6

C. TEXT BOOKS

1. Dr. N. R. Pandya. *Polytechnic Mathematics – II*. Mahajan publishing house, Ahmedabad.

D. REFERENCE BOOKS

1. Prof. R. P. Rethaliya. *Polytechnic Mathematics – II*. Nirav and Roopal prakashan, Ahmedabad.
2. B. M. Patel, Dr. Ajay V. Shah, Mehul B. Patel. *Diploma Engineering Mathematics – II*. Nirali prakashan, Mumbai.

E. COURSE OUTCOMES

COs	Statement
CO1	Understand definition and concept of points like distance between two points, collinear points. Area of triangle, Internal and External Division and examples.
CO2	Understanding definition of Circle, equation of tangent and normal and examples.
CO3	Analyse and evaluate slope and intercept of straight line, slope and equation of line passing through two points, parallel and perpendicular lines.
CO4	Derive and evaluation limit of function, rules and examples.
CO5	Evaluate and Differentiate concept of Differentiation, chain rule, and higher order derivation.
CO6	Investigate and understand rules of Integration, formulae based examples, Integration by parts and examples.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	2	2	2	1	1	1	1	3	3
CO2	3	3	2	2	2	2	2	2	2	1	2	3	3
CO3	3	3	3	2	3	3	2	2	2	3	2	3	3
CO4	3	3	3	3	3	3	2	2	2	3	3	3	3
CO5	3	2	3	3	2	2	2	2	2	2	2	3	3
CO6	3	3	3	2	2	2	2	2	3	2	2	3	3
Avg	2.8	2.7	2.7	2.8	2.3	2.3	2.3	2	1.8	2	2	3	3

DIPLOMA SEMESTER – II
SUBJECT: ORGANIC CHEMISTRY (23DK-202)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
4	0	3	5.5	60	40	25	50	175

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of Organic chemistry. Students will learn about some very basic concept of chemistry like distillation technique, other purification technique, qualitative and quantitative analysis, IUPAC and stereo isomers, organic synthesis and preparation of organic compounds with their chemical and physical properties, and also with its industrial application, problem solving knowledge and different types of problem and its solution that are used in industries.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Purification of organic compounds: - Purification of organic compounds by crystallization, distillation, sublimation	05	C01 C02
[2]	Detection and estimation: - Detection and estimation of C, H, N, O, S and halogens	05	C01 C02
[3]	IUPAC Nomenclature: - IUPAC Nomenclature of aliphatic, aromatic and hetero-cyclic compounds	05	C01 C03
[4]	Stereo-chemistry: - Stereo isomerism, optical isomerism, geometrical isomerism, Walden-Inversion	05	C01 C03
[5]	Study of Aliphatic compounds: - Study of chemical reaction involving & IUPAC Nomenclature involving in important methods of preparation and chemical properties of following compounds with their uses. Ethane, ethylene, acetylene, ethyl chloride, ethanol, acetaldehyde, acetone, chloroform, acetic acid, ethyl acetate, diethyl ether. Ethylamine, Granger reagent	05	C01 C04
[6]	Coal-tar: - Fractional distillation and production of coal tar, isolation of its components	04	C01 C05
[7]	Study of Aromatic compound: - Study of Aromatic compound & chemical reaction involving in important methods of preparation and their chemical properties of following aromatic compounds. Benzene, toluene, benzene halides, styrene, nitro-benzene, sulphonic acids, aniline, phenol, benzaldehyde, benzoic acid, salicylic acid	06	C01 C04
[8]	Orientation: - Electronic theory of orientation of benzene substitution reactions	03	C01 C04
[9]	Carbohydrates: - Classification of carbohydrates, brief information with their structural formula	05	C01 C06
[10]	Polymers: - Types of polymers, Illustration with their monomers and polymers	05	C01 C06

C. PRACTICAL AND TERM WORK

1. Single compound
2. Binary mixture
3. Preparation of organic compounds

D. TEXT BOOKS

1. B.S.Bahl, *Text book of organic chemistry*. New Delhi: S.Chand publication, 1968.
2. H.M.Chawla, P.L.Soni *Text book of organic chemistry*. New Delhi: S.Chand publication, 1992.

E. REFERENCE BOOKS

1. John L. Kice, Elliot N. Marvell, *Modern principles of organic chemistry and introduction*. New Delhi, Amerind; 1972

F. COURSE OUTCOMES

COs	Statement
CO1	Acquire knowledge of different basic terms included in organic chemistry related to purification technique, qualitative and quantitative analysis, different types nomenclature, organic synthesis, chemical and physical properties of organic compounds, carbohydrates, polymers etc.
CO2	Understand the Various methods of purification of organic compounds. Analyze systematic knowledge of qualitative analysis and quantitative analysis of organic compounds.
CO3	Evaluate the IUPAC nomenclature and structure of simple and complex organic compounds. Understand three dimensional structures of organic compounds and their importance in organic chemistry
CO4	Can illustrate the different chemical reaction and mechanism of organic compounds and also orientation of group on aromatic ring.
CO5	Understand the isolation of various compounds from coal and coal tar.
CO6	Can explain the different biomolecule and polymers with their structures and properties.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	3	2	3	3	3	2	3	3
CO2	3	3	3	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	2	3	3	2	3	2	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	2	3	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	3	2.8	2.8	2.7	2.7	2.8	2.7	3	2.5	3	2.8	3	3

DIPLOMA CHEMICAL SEMESTER – II
SUBJECT: PHYSICAL CHEMISTRY (23DK-203)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
4	0	3	5.5	60	40	25	50	175

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of Physical chemistry. Students will learn about reaction kinetics, catalysis, phase rule, electro chemistry and adsorption with its industrial application, problem solving knowledge and different equipment that are used in industries.

B. COURSE CONTENT

NO	TOPIC	L+T (Hrs)	COs
[1]	Chemical Kinetics: - Rate of Reaction, Rate law, Order of reaction, Molecularity of reaction, Derivation of rate constant for first and second order reaction, Zero order and Pseudo order reaction, half-life period, methods for determination of order of reaction, Theories of rate of reaction, effect of various parameters of rate of reaction, Catalyst and Catalysis, types of catalyst.	9	CO1 CO2
[2]	Colloids: - Basic term with definition, Classification of colloids, types of colloids, methods of preparation & purification of colloids, properties of colloids, Emulsion and Gel with its types, application of colloids.	9	CO1 CO3
[3]	Electrochemistry: - Basic term involved in electrochemistry, Electrodes and its types, Buffer solution & its types, Buffer capacity, Buffer range, Indicators and indicator range, Detail of instrumental methods of titration i.e. Potentiometric, Conductometric, pH-metric methods.	9	CO1 CO4
[4]	Surface Chemistry: - Adsorption and Absorption, Adsorption of Gases, Types of adsorption, Adsorption isotherms, Freundlich's and Langmuir adsorption isotherms, Gibb's equation, Chromatographic and Ion exchange adsorption. Effect of different parameters on adsorption.	7	CO1 CO5
[5]	Phase Rule: - Definition and statement of Phase Rule and term involved in it, one component system i.e. Water system and Sulphur System in detail with its Phase diagrams.	7	CO1 CO6
[6]	Distribution Law: - Nernst's Distribution law, Solution and solubility, solubility and absorption coefficients (α and β), effect of various parameters on absorption, type of binary solutions, application of distribution law and ratio.	7	CO1 CO6

C. PRACTICAL AND TERM WORK

1. Hydrolysis In Acid Media
2. Hydrolysis In Alkali Media
3. Distribution Co-Efficient

4. Adsorption
5. Two Component Systems
6. Heat Of Solution
7. Surface Tension
8. pH Metry
9. Conductometry
10. Potentiometry

D. TEXT BOOKS

1. B. S. Bhal, Arun Bhal & G. D. Tuli, *Essentials of Physical Chemistry*. New Delhi: S. Chand & Publication, 1943.
2. Samuel Glasstone, *Elements of Physical Chemistry*. Macmalin & co. Ltd. London, 1960

E. REFERENCE BOOKS

1. Jain & Jain, *Engineering Chemistry*, Dhanpat Rai Publication Company, 2004.

F. COURSE OUTCOMES

COs	Statement
CO1	Acquire knowledge of different basic terms included in chemical kinetics, colloids, surface chemistry, electrochemistry and phase rule as well as distribution law.
CO2	Way of determine order of different reaction, affecting parameter and theories. Calculating rate as well as order of reactions. General concepts of Catalyst & catalysis.
CO3	Student learn about the properties, nature & characteristics of colloids & way of preparation with purification techniques. Different applications of it.
CO4	Types of cell and their potential calculation & formulation. Also get basic knowledge of classical electro-analytical methods.
CO5	Get the basic idea about surface & bulk phenomena and be able to apply them in routine use.
CO6	Use of phase rule to understand different systems. Affecting parameters on phase equilibrium. Get idea about distribution concept & its application in industrial processes & in general chemistry.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	3	3	3	2	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	2	2	3	3	3	2	3	3	3	3
CO6	3	3	3	3	2	3	3	3	2	3	3	3	3
Avg	3	2.8	2.8	2.6	2.5	3	3	3	2.5	3	2.8	3	3

DIPLOMA SEMESTER – II**SUBJECT: CHEMICAL ENGINEERING MATERIAL (23DK-208)**

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	0	0	3	60	40	-	-	100

A. COURSE OVERVIEW

The course imparts study of various process technologies and fundamental types of various engineering materials. Chemical Engineering Materials involves transforming raw materials into valuable end-products, the development of high-performance materials for our modern society, and understanding its various properties & applications.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction & properties of material: - General principles of selection of materials. Definition & explanation of melting point, boiling point, specific heat, thermal conductivity, thermal expansion, thermal insulation, stresses, strain.	3	CO1
[2]	Corrosion: - Definition, mechanism of corrosion, types of corrosion, dry & wet corrosion, direct corrosion, electro-chemical corrosion galvanic corrosion, high-temperature corrosion, atmospheric corrosion. Factors affecting/influencing corrosion rate, brief description, different methods for corrosion control and prevention.	11	CO1 CO3
[3]	Metals: - General comparison of ferrous, non-ferrous & alloys. Properties of metals Cast iron, wrought iron, steel, Aluminium, zinc, chromium, nickel, tin, titanium, tungsten, platinum, silver, lead. Properties of alloy duralumin, Y-alloy, brass, bronze, Inconel, invar, Hastelloy, alloy steel. Types of furnaces for metal purification, blast furnace, arc furnace.	11	CO1 CO2 CO3
[4]	Ceramic materials: - Definition of ceramic materials. Clay-chemical composition China clay, fire clay, bentonite. Refractories- definition, properties & classification of refractories. Bricks- manufacture, properties, uses & types of bricks. Glasses- definition, raw materials used & their effect on glass product, manufacture of glass in brief, types of glass, their properties & uses, soda lime, borosilicate, high silica, fibre, wool & foam glass. Porcelain- properties, composition & uses.	11	CO1 CO2 CO4
[5]	Organic and other materials: - Polymers & their structure, addition & condensation polymerization. Plastic- definition, properties & classification. Rubber/Elastomers- definition, classification, sources, properties & uses of natural and synthetic rubber, vulcanization. Wood- properties, seasoning types, its advantages & limitations	11	CO1 CO2 CO5
[6]	Coatings: - Protective coatings, Metallic coating, chemical conversion coating, organic coating, ceramic coating, Paints- classification, ingredients of paints, their properties and importance,	07	CO1 CO5

	special types of paints & their application. Varnishes- definition, ingredients & classification.		
[7]	Materials for special application: - Lubricants- definition, importance, types, properties & application, method of applying lubricants. Insulation- definition, types of insulating materials, electrical, thermal & sound insulation. Adhesive- definition, classification, advantages & limitations, mechanism of their effect on surface.	06	CO1 CO4

C. TEXTBOOKS

1. S.K. Hajra Choudhury., *Materials Science and Processes*, Indian Book Distributing Co., 1978.
2. S.C. Rangwala., *Engineering Materials.*, 3rd Edition, Charotar Book Stall, Anand, India., 1976.

D. REFERENCE BOOKS

1. Frank Rumford., *Chemical Engineering Materials*, Nabu Press., 2011.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering	General Introduction, knowledge, and definition of various materials and their basic properties.
CO2	Understanding, Remembering	Methods, processes, and working of equipment's for obtaining various material.
CO3	Understanding, Remembering	To understand types of corrosion, its classification, mechanism, and factors affecting as well needed precaution methods. Also, to know types, properties, and application of Metals.
CO4	Remembering	To know types, properties, effect, and application of Ceramic Materials, Lubricants, Insulators and Adhesions.
CO5	Remembering	To know types, properties, effect, and application of Polymers, Plastics, Rubber, Wood, Coatings, Paint and Varnish.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	2	3	2	3	3	3
CO2	3	3	2	2	3	3	3	3	2	3	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	3	3	2.8	2.8	3	3	3	3	2.6	3	2.6	3	3	3

DIPLOMA SEMESTER – II
SUBJECT: ELEMENTS OF MECHANICAL & ELECTRICAL ENGG.
(25DK-212)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	0	0	3	60	40	-	-	100

A. COURSE OVERVIEW

The course is introducing general concept and their controls of basic concepts of Mechanical Engineering and Electrical Engineering. Students will learn about Steam boilers, Prime movers, IC Engines, Material Handling Equipments, Welding Processes, and Power Transmission Systems. Also the concepts about Basic electrical engg, AC Circuits, Electrical Machines etc.

B. COURSE CONTENT

NO	TOPIC	L+T (Hrs)	COs
[1]	Boilers: - Definition, Function, Classification, working principles of Babcock & Wilcox boiler & Cochran Boiler, Introduction to Boiler mountings & accessories, Different types of mountings & accessories-their application & working principle.	07	CO1 CO4
[2]	Prime movers: - Introduction, Function, Classification of prime mover, Working principle of Internal combustion engines, Four stroke (Petrol & Diesel) Two stroke(Petrol & Diesel), Introduction to Recent trends eg. MPFI (Multi Point Fuel Injection), DTS-I (Digital Twin System. Ignition)	06	CO1 CO3 CO4
[3]	Power transmission & Safety: - Introduction to power transmission, Modes of power transmission, Belt drives and its Numericals, Rope drives, Gear drives, Chain drive system, Causes of accidents & their remedies.	09	CO1 CO4
[4]	Material Handling Equipments: - Introduction, Classification of material handling equipments, Factors affecting the selection of Material Handling Equipments Hoisting equipments, conveying equipments, Selection of suitable material handling equipments for the given situation.	05	CO2
[5]	Fundamentals of Electrical engineering: - Modern electron theory, Basic electrical quantities (Current, Voltage, Resistance etc), Ohm's law, Farade's law of Electromagnetic Induction.	06	CO1 CO5 CO6
[6]	Welding: - Introduction to metal joining processes, Classification, Definition of Welding, Classification of welding, Arc welding: definition, working principle, types, equipments, electrode codification; Gas welding : definition, working principle, types, equipments, Types of welding flames, Flux, Brazing, Soldering, Safety precaution during welding process.	09	CO1 CO3 CO6
[7]	A.C. and D.C. Circuits: -Introduction to electrical circuits, Fundamentals of A.C./ D.C. Circuits, Parallel and Series Connections, Examples, Star and Delta connection, Examples.	09	CO1 CO3 CO6

[8]	Electrical Machines: - Motor, Generator, Transformer- Introduction, Working principles, construction, Application, Specifications, Introduction, External connections of Electrical appliances (Single phase energy meter, A' meter, Voltmeter, Fan, Fluorescent tube)	06	CO1 CO5 CO6
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C. TEXT BOOKS

1. Elements of Mechanical Engineering by N.M.Bhatt,
2. Elements of Electrical Engineering by R.P.Ajwalia

D. REFERENCE BOOKS

1. Basic Mechanical Technology by P.S.Desai, S.B.Soni

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering	The general introductions and concept of Mechanical & Electrical Engineering.
CO2	Analysing	To choose appropriate devices for any given conditions.
CO3	Applying	To apply basic concepts in industrial devices.
CO4	Understanding	To understand and importance of Mechanical & Electrical Engineering.
CO5	Remembering	Types of Mechanical & Electrical Devices used in industries.
CO6	Understanding	To Understand working principles, operations of various machines.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO6	3	3	3	3	2	3	3	3	2	3	3	3	3	3
Avg	3	2.6	2.5	2.6	2.5	3	3	3	2.5	3	3	3	3	3

DIPLOMA SEMESTER – II
SUBJECT: WORK SHOP (23DK-207)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
0	0	2	1	-	-	50	-	50

A. COURSE CONTENT

NO	TOPIC
[1]	Introduction to work-shop: - Work-shop layout, Importance of various sections/shops of workshop, Type of jobs done in each shop, General safety rules and work-procedure of work-shop.
[2]	Fitting: - Fitting tools like – files, vice, chisels, panch, scribe, hammers, surface plate, try square, calipers etc., fitting operations such as chipping, filing, scraping, grinding, sawing, marking, drilling, reaming, tapping, safety precaution, Demonstration of various operations, Preparation of male-female joints.
[3]	Smithy: - Smithy tool like - hammer, tongs, Anvil, flattener etc., Smithy operations such as upsetting, drawing down, bending, setting down, for welding, cutting, punching and fullering etc., Safety precautions, Demonstration of various smithy operations.
[4]	Tin smithy: - Tin smith tools like – hammers, stakes, scissors etc., sheet metal operations such as shearing, bending, joining, safety precautions, demonstration of various operations.
[5]	Carpentry: - Carpentry tools like – saw, planer, chisels, hammers, pallet, marking gauge, vice, tee square, rule etc., carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, type of woods and carpentry hardware, safety precaution, demonstration of various operations by using hardware.
[6]	Pipe fitting: - Pipe fitting tools, pipe fitting operations such as marking, cutting, bending, threading, assembling, dismantling etc., types of various spanners such as flat, fix, ring, box, adjustable etc., safety precautions, demonstration of various operations.
[7]	Metal joining: - Metal joining hand tools and equipments, permanent and temporary methods for metal joining such as screw, nuts bolts and washers, rivets, keys, pins and welding soldering brazing, demonstration of metal joining operations, safety precaution.
[8]	Turning: -Turning operations such as facing, centering and turning, demonstration of different lath parts and demonstration of above operations.
[9]	Maintenance: - Demonstration of dismantling, overhauling, aligning and assembling of pump and motors, demonstration of disassembly, overhauling and assembly of motor, alignment of pump and motor.

SEMESTER-III

Subject	Teaching Scheme (hrs/week)			Total hr	Credit	Examination Scheme				
	L	T	P			Th.	S	P	TW	Total
Mechanical Operations	4	0	3	7	5.5	60	40	50	25	175
Chemical Process Industries	3	0	2	5	4	60	40	50	25	175
Industrial Safety & Environmental Engineering	3	0	2	5	4	60	40	50	25	175
Plant Utility & Energy Engineering	3	0	0	3	3	60	40	-	-	100
Plant Design, Management & Economics	3	0	0	3	3	60	40	-	-	100
IKS & Yoga	1	0	2	3	2	-	-	50	-	50
Total	17	0	9	26	21.5	300	200	200	75	775

DIPLOMA CHEMICAL SEMESTER – III
SUBJECT: MECHANICAL OPERATION (23DK-301)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
4	0	3	5.5	60	40	25	50	175

A. COURSE OVERVIEW

The course cover the fundamental aspects size reduction, different equipment that use for size reduction. Also cover different mechanical operation like mixing, agitation, sedimentation and filtration.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction of Mechanical Operation:- Definition of Unit Operation and Unit Process, Difference between Unit operation and Unit Process, Examples of Unit Operation & Unit Process.	01	C01
[2]	Properties of particulate solids:- Specific properties of solids, Density & Bulk density. Definition and calculation of particle diameter, Sphericity, equivalent diameter, specific surface area, volume surface mean diameter, mass mean diameter, shape factor, Calculation of no. of particles.	07	C01 C02
[3]	Screen Analysis:- Need of screen analysis, Types of screen analysis, Application of screen analysis, Types of screens, trommel, grizzlies, Vibrating screen etc. Ideal & actual screen, Capacity & effectiveness of screen (With derivation). Calculation of capacity and effectiveness of screen, faults in screening.	12	C01 C03
[4]	Size Reduction:- Definition and need of size reduction, Principles of size reduction, characteristics of comminuted products, Energy & power requirements in comminution, laws of size reduction, work index, Types of size reduction equipment with their principle, construction & working, derivation of equation of angle of nip and critical speed. Calculation of angle of nip, capacity & Ribbon factors. Open & close circuit grinding.	10	C01 C02 C03
[5]	Sedimentation:- Definition of sedimentation, theory of bath sedimentation, Interphase height and time curve, Flocculation principle, Gravity thickener. Explanation of free and hindered settling, cyclone separator, efficiency of cyclone separator. Definition of Stoke's law and Newton's law for terminal settling velocity.	10	C01 C04
[6]	Filtration:- Definition and applications of filtration, Equipments for liquid – solid separation., Filter press, Rotary vacuum filter, filter media and its required characteristics, filter aids and method of application, calculation of special cake resistance, filter media resistance, porosity for constant rate, constant pressure system and vacuum drum, constant rate filtration and constant pressure filtration, classification of centrifugal equipment, batch centrifuge, Advantages and disadvantages of centrifuge over filter press.	12	C01 C04 C05

[7]	Agitation and Mixing: - Classification of Impellers, vortex formation and swirling, methods of vortex prevention, factors affecting agitation, Purpose of mixing solids and paste, Principle construction & working of Ribbon blender, Muller mixer, Banbury mixer & Kneaders.	08	CO1 CO6
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C. PRACTICAL AND TERM WORK

1. Sieve Analysis
2. Sieve Efficiency
3. Jaw Crusher
4. Roll Crusher
5. Ball Mill
6. Sedimentation
7. Froth Floatation
8. Power Calculation for Agitated Vessel
9. Elutriator

D. TEXT BOOKS

1. McCabe & Smith, *Unit Operation in Chemical Engineering*; 5th ed.; McGraw Hill Book Company; New York, 1993
2. K A Gavhane, *Unit Operation I*; 3rd ed.; Nirali Prakashan, Pune, July 2015

E. REFERENCE BOOKS

1. Coulson and Richardson *Chemical Engineering Vol. I*; 7th ed; Landon: 1999.

F. COURSE OUTCOMES

COs	Statement
CO1	To impart the basic concepts of mechanical operations in chemical process industries.
CO2	To develop understanding about size analysis with the help of equipments and properties of particulate solids.
CO3	Understanding of different equipments and laws of size reduction and deriving the equation for angle of Nip and Critical Speed.
CO4	To get knowledge for mixing and agitation operation and classify and explain solid-solid, solid-fluid related operations.
CO5	Understand mechanical separation methods such as filtration, and sedimentation by using different equipments.
CO6	Understanding of theory and derivation for filtration process and sedimentation process.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	2	3	2	3	2	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3
Avg	3	3	3	2.8	3	2.6	3	2.8	2.6	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – III
SUBJECT: CHEMICAL PROCESS INDUSTRIES (23DK-308)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	0	2	4	60	40	25	50	175

A. COURSE OVERVIEW

The course imparts study of various process technologies and fundamentals of various organic and inorganic process industries. It helps in understanding manufacturing, various process parameters, basic functioning of equipment's and engineering problems for various industries.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Introduction: -General Survey of Chemical Industries, Importance contribution to human life & classification of chemical industries. Fuels: - Classification of fuels, Fuel gases.	10	C01 C02
[2]	Chlor-Alkali Industry: - Manufacture of Soda ash, Caustic Soda, Chlorine & Hydrogen. Cement Industries: - Types of cement, classification of cement, manufacturing of cement & major engineering problems of cement industries.	10	C01 C02 C03 C04
[3]	Marine chemicals: - Chemicals from seawater, manufacture of common salt and. bromine. Pharmaceuticals: - Classification of drugs, manufacture of penicillin and aspirin.	07	C01 C02 C03 C05
[4]	Oil & Fats Industries: - Classification of oil & fats, Extraction of vegetable oil, Hydrogenation of oil, manufacture of soap and glycerine, major engineering problems of all such industries.	08	C01 C02 C03 C05
[5]	Electrochemical Industries: - Types of electrochemical Indus., electroplating and refining of Aluminium.	05	C01 C03 C05
[6]	Carbohydrate Industries: - Manufacture of sugar and starches. Ethanol from molasses by fermentation, major engineering problems. Pulp and Paper Industries: - Methods of pulp production, manufacture of pulp by Kraft process, recovery of chemicals from black liquor & major engineering problems.	10	C01 C02 C03 C06
[7]	Dyes & Intermediates: - Classification of dyes, manufacture of H-acid and B-naphtha. Pesticides: - Classification of pesticides, manufacture of parathion, 2-4-D, BHC.	10	C01 C02 C03 C06

C. PRACTICAL AND TERM WORK

1. Acidity of Milk
2. Purity of washing Soda
3. Casein Production from milk

4. Preparation of Phenolphthalein
5. Preparation of Soap
6. Preparation of Caustic Soda
7. Preparation of Barium Sulphate

D. TEXTBOOKS

1. M. Gopala Rao, Marshall Sittig., *Dryden's Outlines of Chemical Technology*, 3rd Edition, East West press private limited, New Delhi.

E. REFERENCE BOOKS

1. George T. Austin., *Shreve's Chemical Process Industries*, 3rd Edition, Tata McGraw Hill.
2. W. L. Faith, Donald B. Keyes, Ronald L. Clark., *Industrial chemicals*, John Wiley and Sons, New York, 1950.

F. COURSE OUTCOMES

COs	Statement
CO1	To know the basics of various chemical industries and to know various unit operation and unit processes for manufacturing.
CO2	To identify and solve engineering problems during production.
CO3	To develop the comprehensive understanding about the fundamental knowledge and manufacturing process for various chemical products.
CO4	To understand the treatment, reaction, and separation steps in a flow diagram of chemical production processes for fuel gases, chlor-alkali, and cement industries.
CO5	To understand the treatment, reaction, and separation steps in a flow diagram of chemical production processes for marine chemicals, pharmaceuticals, oil & fat, and electrochemical industries.
CO6	To understand the treatment, reaction, and separation steps in a flow diagram of chemical production processes for carbohydrate, pulp & paper, pesticides, and dyes & intermediate industries.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	3	2	3	3	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	2	3	2	2	3	3	3	3
CO5	3	3	3	2	3	2	3	2	2	3	3	3	3
CO6	3	3	3	2	3	2	3	2	2	3	3	3	3
Avg	3	2.8	3	2.3	3	2.5	3	2.5	2.5	3	3	3	3

DIPLOMA CHEMICAL SEMESTER- III
SUBJECT NAME: INDUSTRIAL SAFETY & ENVIRONMENTAL ENGINEERING
(25DK - 319)

Teaching scheme, Hr/week			Credits	Examination scheme (Marks)				
L	T	P		Ext.	Int.	TW	P	Total
3	0	2	4	60	40	25	50	175

A. COURSE OVERVIEW

The course introduces fundamental concepts of industrial safety, environmental protection, and pollution control. Students will gain knowledge about safety objectives, the role of chemical engineers in safety management, and various industrial hazards including chemical, mechanical, electrical, and fire hazards, along with their prevention and control measures. Additionally, the course covers environmental pollution, including water pollution, noise pollution, miscellaneous pollution sources, and solid waste disposal techniques, ensuring a comprehensive understanding of industrial safety and environmental engineering.

B. COURSE CONTENT

SR. NO.	TOPIC	(L+T) Hrs.	COs
1	General Introduction to Industrial Safety Introduction of Safety, Hazard, Risk, and Accident ; Difference between Hazard and Risk , Types of Hazards in Industries (Chemical, Mechanical, Electrical, Fire, etc.), Importance of industrial safety in chemical plants and process industries , Role of safety management in accident prevention, Impact of industrial accidents on workers and environment , Behavior-Based Safety (BBS)	8	CO1
2	Hazard Identification & Risk Assessment Definition and Importance of HIRA, Hazard Identification (Physical, Chemical, Biological, Ergonomic, etc.), Risk Assessment (Likelihood vs. Severity Matrix), Risk Control Measures (Hierarchy of Controls – Elimination, Substitution, Engineering, Administrative, PPE), Application of HIRA in chemical industries and process plants , Fault Tree Analysis (FTA), Event Tree Analysis (ETA)	9	CO2
3	Case Studies & Safety Management Introduction to Industrial Accidents and their impact on workplace safety, Definition and Importance of Safety Audits, Definition and Objectives of Emergency Planning, Disaster Management Plans (DMPs) for industrial plants, PPE, Safety Signage, Fire Safety, First Aid.	7	CO3
4	Introduction to Environmental Pollution Introduction to environmental pollution, sources of pollutants, effects of pollution on human health, vegetation, animal life & effect on environment. & Miscellaneous Pollution: Sources types of effect of Air pollution, Water pollution, noise pollution, radiation etc. Air pollution control measurement devices for gaseous and solid pollutants, Solid	6	CO4

	waste of disposal methods like dumping, sanitary land filling, incineration, composting etc.		
5	Environmental Laws & Regulations Environmental Protection Act (EPA), 1986, Water (Prevention & Control of Pollution) Act, 1974 with characterization and treatment methods like ETP, STP, CETP; Air (Prevention & Control of Pollution) Act, 1981, Waste Management in Industries	6	CO5
6	Sustainable Development & Green Practices Definition & Importance of renewable energy, Types of Renewable Energy Source, Advantages of Renewable Energy over fossil fuels, Challenges in Renewable Energy Implementation (storage, grid integration, cost factors), Definition & Concept of carbon footprint, Major Sources of Carbon Emissions, Strategies for Carbon Footprint Reduction.	6	CO6

C. PRACTICAL AND TERM WORK

1. Introduction to Safety
2. To study about various disaster in India.
3. To study about personal protective equipment.
4. To study Fire, Hazard & different types of fire extinguisher.
5. Determination of free CO₂ in a given water sample.
6. To determine dissolved oxygen in the given water sample.
7. Determination of Total Hardness of water by EDTA method.
8. Determination of total residual chlorine in a water sample.
9. To determine biological oxygen demand (BOD) of a given water sample.
10. To determine alkalinity and acidity of given water sample.

D. TEXT BOOKS

1. R.K. Jain & Sunil S. Rao, "Industrial Safety, Health and Environment Management Systems", Khanna Publishers.
2. K.U. Mistry, "Fundamentals of Industrial Safety and Health" Siddharth Prakashan.
3. C.S. Rao, "Environmental Pollution Control Engineering" (2nd ed.). New Age International Publishers.
4. ડૉ. વી. કે. શાહ (2021). ઔદ્યોગિક સલામતી અને જોખમ વ્યવસ્થાપન. અમદાવાદ: યુનિવર્સલ પ્રકાશન.
5. કે.ડી. પટેલ (2018). પર્યાવરણીય કાયદા અને નીતિ. અમદાવાદ: ગુજરાત લો હાઉસ.

E. REFERENCE BOOKS

1. Danieal A. Crowel & Joseph. F, 2nd edition, Prentice hall PT, New Jersey, 2002.

F. COURSE OUTCOME

CO Number	Statement
CO1	Understand the key concepts of safety, hazard, risk, accident, and industrial safety principles in chemical plants.
CO2	Perform hazard identification and risk assessment (HIRA) using structured techniques like FTA and ETA.
CO3	Analyze industrial accidents, apply safety management practices, and develop emergency preparedness plans.
CO4	Understand environmental pollution, its sources, types, and impacts on human health and ecosystems.
CO5	Apply environmental laws and regulations relevant to industrial processes including waste and pollution control.
CO6	Promote sustainable development by evaluating renewable energy options and carbon footprint reduction strategies.

G. COURSE MATRIX

	CO1	CO2	CO3	CO4	CO5	CO6	AVG.
PO-1	3	3	3	3	3	2	2.8
PO-2	2	3	2	2	3	2	2.3
PO-3	2	3	2	2	2	2	2.2
PO-4	2	2	2	1	1	2	1.6
PO-5	1	2	2	1	1	2	1.5
PO-6	3	2	2	3	3	3	2.6
PO-7	3	2	2	3	3	3	2.6
PO-8	2	1	2	2	2	3	2.0
PO-9	2	1	2	2	2	2	1.8
PO-10	2	2	2	1	1	2	1.8
PO-11	1	1	2	1	1	2	1.3
PSO-1	3	3	3	2	2	2	2.5
PSO-2	2	2	2	3	3	3	2.5

DIPLOMA CHEMICAL SEMESTER – III

SUBJECT: PLANT UTILITIES & ENERGY ENGINEERING (23DK-320)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	0	0	3	60	40	-	-	100

A. COURSE OVERVIEW

This subject provides students with a comprehensive understanding of the various utilities that support the operation of chemical process plants. It emphasizes the role of essential services such as water supply, steam generation, refrigeration and compressed air along with their efficient and safe operation. The course also introduces the principles of energy management and conservation, enabling students to evaluate utility systems from both operational and sustainability perspectives.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction: -Types of energy, energy crisis, Renewable sources of energy, conventional & non-Conventional sources of energy, energy conservation.	5	CO1 CO2
[2]	Conventional fuels: - Classification, types, sources, properties, uses, storage, handling & selection factors of various conventional fuels in the form of a. Solid: Coal, Lignite, Coke b. Liquid: Gasoline, Kerosene, Naphtha, Fuel oil, Diesel c. Gaseous: N.G., Refinery gas, Water gas, Producer gas, Coke oven gas, LPG, Oil gas, Industrial Gases etc	10	CO2
[3]	Non-conventional sources of energy: - Solar energy: Solar radiation, collectors, storage & applications Wind energy: Introduction, nature of wind & wind farm Biomass energy: Introduction, Biomass conversion technology by wet & Dry process Geothermal energy: Introduction & Sources of geothermal energy. Nuclear energy: Introduction, Nuclear Fuels & Nuclear reactions, types of Propellant & moderators	15	CO1 CO3
[4]	Water & Steam: - Importance, Consumption & source of water, water analysis, types of hardness, methods of softening of water like lime soda, zeolite, ion exchange methods etc., Purification of water by screening, sedimentation, coagulation, filtration & sterilization, treatment for boiler feed water, Reuse & Recycling of process water, definition of enthalpy, wet steam, superheated steam, specific volume, Types-classification & comparison of steam generators, Factors affecting the selection of steam generator	15	CO4
[5]	Air & Refrigeration: - Introduction, use of air as chemical raw material & utility, concept of compressed air, blower air, fan air, instrument air etc., various methods of refrigeration in brief like ice, evaporate, vapor, steam jet refrigeration etc, types of refrigerating agent like ammonia, carbon dioxide, methylene chloride, water	15	CO5

brine etc., selection of refrigerating agents		
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C. TEXT BOOKS

1. Dryden's Outlines of Chemical Technology, 2nd Ed. By M. Gopala Rao & Marshall Sittig, East West Press Pvt. Ltd., New Delhi.

D. REFERENCE BOOKS

1. Shreve's Chemical Process Industries, 5th Ed. By, George F. Austin McGraw Hill International Edition.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remember	Gain sufficient knowledge about the various fuels and energy sources with applications in industrial processes.
CO2	Understand	Classify Conventional sources of energy requirements and give their importance in present day.
CO3	Understand	Able to acquire the knowledge on various alternate energy technologies and their importance in fulfilling the present-day energy needs
CO4	Apply	Select appropriate utility for heating and cooling application.
CO5	Understand	To study requirement of different utilities for the process, along with its generation and it's effective utilization.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	3	2	2	2	2	2	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	2	2	2	2	3	3	3	3	3
Avg	3	2.6	2.8	2.6	2.8	2.8	2.6	2.6	2.6	2.8	2.6	3	3	3

DIPLOMA CHEMICAL SEMESTER – III
SUBJECT: PLANT DESIGN, MANAGEMENT & ECONOMICS (23DK-318)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	0	0	3	60	40	-	-	100

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of fluid flow behaviour. Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Organization Structure and organizational Dynamics:- Definition, scope organization Structure, Definition, Goals of Organization Structure Line Organization basics, application, Functional Organization basics, application, Line & staff Organization basics, Committee Organization basics, Principles of Organization, Principles of Organization, differences between various types of Organization, Organization culture & factors affecting it.	8	CO1 CO4
[2]	Material, Finance, Production & Marketing Management:- Definition, Function, Importance & brief idea about all these kind of management.	5	CO1 CO3 CO4
[3]	Production, Planning and Control: - Concept of Production, planning and control, Objectives, functions of production, planning and control etc.	4	CO1 CO4
[4]	Introduction of Plant Design: - Importance of Chemical Engg. Plant Design, Role of chemical engineer in Plant Design, Need for Plant Design, Basis for good design, Relation of Plant Design with sales.	5	CO2
[5]	Development of Chemical Plant Project: - Objectives for development of project, Process evaluation stages with description, Technical factors, Economic factors, Legal phase, and sources of information.	4	CO1 CO5 CO6
[6]	Process Design for Chemical Plant: - Choice of process, selection of process cycle, continuous versus batch process, shift-operating time schedules types of flow diagrams.	4	CO1 CO3 CO6
[7]	Selection of Chemical Process equipments, Auxiliaries & Material: - Selection of process equipment , Standard vs. special equipment, Selection of various equipments like size reduction, material handling, heat transfer, mass transfer equipments etc., selection of pumps, Piping, - ferrous pipe and tubes, non- metallic pipe, Selection of pipes & Tubes, Insulation, types of insulation, factors governing selection of insulation, application of pipe insulation	6	CO1 CO3 CO6
[8]	Layout & Location of Chemical Plant: - Importance of plant layout, factors in planning layout, methods of layout planning, unit area concept,	6	CO1 CO5 CO6

	two dimensional layout, scale models, principles of plant layout, site location, Primary and secondary factors considered in the plant location.		
[9]	Plant Economics: - Estimation of total product cost, fixed capital investment, working capital investment, over-head charges, payout period, Break-even point, Causes of Depreciation, types and methods of determining depreciation	6	CO1 CO4 CO6

C. Text Books:

1. Plant design & Economies for Chemical Engineers - M.S.Peters and K.D.Timmerhaus
2. Chemical Engineering Plant Design - F.C.Vilbrandt and C.E.Dryden.
3. Industrial Management. – Atul Prakashan.

D. Reference Books:

1. Modern production Management - Butta.
2. Material Management - N. Nair.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering	The general introductions and concept of Economics, Plant Design and Management.
CO2	Analysing	To choose appropriate devices for any given conditions.
CO3	Applying	To apply basic concepts in industrial management concepts.
CO4	Understanding	To understand and study of Plant Design, Industrial aspects.
CO5	Remembering	Types of Economics Aspects, Design Aspects used in industries.
CO6	Understanding	To Understand principles, calculation, flow diagrams in Plants.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO6	3	3	3	3	2	3	3	3	2	3	3	3	3	3
Avg	3	2.6	2.5	2.6	2.5	3	3	3	2.5	3	3	3	3	3

SEMESTER-IV

Subject	Teaching Scheme (hrs/week)			Total hr	Credit	Examination Scheme				
	L	T	P			Th.	S	P	TW	Total
Heat Transfer	4	0	3	7	5.5	60	40	50	25	175
Fluid Flow Operations	4	0	3	7	5.5	60	40	50	25	175
Process Calculations	3	1	0	4	4	60	40	-	-	100
Mass Transfer-I	4	0	3	7	5.5	60	40	50	25	175
Instrumentation	3	0	0	3	3	60	40	-	-	100
Chemical Engineering Equipment Drawing	0	0	3	3	1.5	-	-	50	25	75
Total	18	1	12	31	25	300	200	200	100	800

DIPLOMA CHEMICAL SEMESTER – IV
SUBJECT: HEAT TRANSFER (23DK-403)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
4	0	3	5.5	60	40	25	50	175

A. COURSE OVERVIEW

The course cover the fundamental aspects of Heat Transfer through convection, conduction and radiation. Derivation of heat loss for difference shapes. Understanding of Heat Exchanger and Evaporation by their industrial application.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Fundamentals of Heat Transfer: - Introduction, Engineering heat transfer and analogies between various transport processes, modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzmann law, Thermal conductance and resistance, Convective and radiative conduction, Combined heat transfer process.	6	CO1
[2]	Steady State Heat Transfer by conduction: - Concept of heat conduction, Linear one-dimensional Heat conduction through wall, through cylinder and through sphere, Conduction through composite plane wall, conduction through composite cylinder, conduction through composite sphere, critical insulation thickness for pipes. Heat Transfer by Convection: - The nature of heat convection, The Nusselt Number, Determination of Nusselt Number, Forced convection (No derivation), Free convection (No derivation)	10	CO1 CO2
[3]	Heat Transfer By Phase Change: - Heat transfer accompanied by phase change, Phenomenon of boiling, Regimes of pool boiling, Nucleate boiling & film boiling, Phenomenon of condensation.	5	CO5
[4]	Thermal Radiation: - Nature of thermal radiation, Absorption, Transmission, Reflection and Emission of Radiation, Emissive power of black body, Plank's distribution, Total emissive power, stefan-Boltzman law, Emissivity, Kirchoff's law, Black body, Wien's displacement law, radiation shields.	8	CO1 CO2
[5]	Heat Exchangers: - Introduction, types of heat exchangers, overall heat transfer coefficient, Effect of scale formation, logarithmic mean temperature difference, L.M.T.D. correction factors, Extended surfaces.	11	CO3
[6]	Evaporation:- Introduction, Liquid characteristics, types of evaporator, Duhring rule & boiling point elevation, economy & capacity, method of feeding, examples based on single effect evaporator.	8	CO4

C. PRACTICAL AND TERM WORK

1. Thermal Conductivity of Composite Wall
2. Heat transfer coefficient in unsteady state
3. Pin fin Apparatus
4. Emissivity measurement apparatus
5. Thermal Conductivity for Lagged Pipe
6. Forced Convection apparatus
7. Concentric Tube Heat Exchanger
8. Plate Type Heat Exchanger
9. Dropwise and Filmwise Condensation
10. Shell & Tube Heat Exchanger

D. TEXT BOOKS

1. K A Gavhane, *Unit Operation II*; 3rd ed.; Nirali Prakashan, Pune, July 2017
2. McCabe and Smith, *Unit Operations of Chemical Engineering*; 4th ed.; McGraw Hill Book Company; New York, 1986

E. REFERENCE BOOKS

1. D.Q. Kern *Process Heat Transfer*; 3rd ed; Wiley Global Headquarters: USA 2019.

F. COURSE OUTCOMES

COs	Statement
CO1	How conduction, convection and radiation is proceed in daily life and in chemical industries.
CO2	Compare and understand Fourier's law, Newton's law, and Stefan Boltzmann law for mode of heat transfer with derivation of heat loss.
CO3	Demonstrate terminology of heat exchanger.
CO4	Understand the role of evaporator in industries.
CO5	Demonstrate condensation and boiling phenomena.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	2	3	2	3	2	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3
Avg	3	3	3	2.8	3	2.6	3	2.8	2.6	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – IV
SUBJECT: FLUID FLOW OPERATION (23DK-407)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
4	0	3	5.5	60	40	25	50	175

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of fluid flow behaviour. Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Fluid Statics: - Definition of fluid, fluid mechanics, static pressure, head, gauge pressure, absolute pressure, dynamic pressure, vacuum. Pressure measuring devices, Simple U tube manometer, differential U tube manometer, inclined tube manometer, measurement of absolute and gauge pressure by manometer, manometric liquids, purpose of pressure measurement. Mechanical pressure gauges, Bourdon tube, diaphragm & bellows gauges. Derivation & Calculation of pressure drop.	10	CO1 CO2
[2]	Fluid dynamics: - Purpose of flow measurement, definition of average mass & volumetric flow rates, Classification of flow meters, orifice meter, venturimeter, pitot tube, flow nozzle, rotameter, open weirs. Comparison & merits-demerits of flow meters. Calculation of flow rates by direct use of formulas	10	CO2
[3]	Behaviour of different types of fluids: - Definitions of ideal & real fluids, Newtonian & non-Newtonian fluids, behaviour of non-Newtonian fluids, definitions of different viscosities, viscosity measurement by Hagan Poiseuille's method, steady state & unsteady state flow. Reynold experiment, conclusions, definition of laminar flow, turbulent flow, and Reynold number, critical velocity, transition flow, assumptions of simple & modified Bernoulli's equation and its applications. Friction factor chart, significance, roughness parameter, relative roughness, skin friction, form friction comparison. Derivation of Fanning's friction equation. Head loss & pressure drop through pipe calculation. net head developed by pump, fluid HP, BHP calculation.	15	CO1 CO3
[4]	Transportation of fluids: - Pipes, tubes, pipe size, pipe fittings, their uses & sketches, joints-flange, expansion, Different types of valves, their construction, function & uses. Classification of pumps. Centrifugal pumps- volute & turbine type. Positive displacement pumps & gear, sliding vane, lobe, piston, plunger & diaphragm types fans – centrifugal forward & backward curved blades type. Blowers & compressors – reciprocating & rotary types (all fluid moving machineries are in brief) characteristic curves of centrifugal pump.	15	CO4

	Derivation of NPSH & calculation. Cavitation – causes & remedies.		
[5]	Conveying: - Pneumatic type – vertical & horizontal types, Hydraulic type – vertical & horizontal types homogeneous flow & Industrial applications	3	CO5
[6]	Fluidization: - Aggregative & particulate types. Mechanism, applications, calculation of pressure drops through fluidized bed. Comparison of packed & fluidized beds, their merits, demerits & applications.	4	CO1
[7]	Level measurement: - Direct level measurement – tape, sight glass & float methods. Indirect level measurement – Air trap box, diaphragm box, bulbar system, differential U tube manometer methods.	3	CO5

C. PRACTICAL AND TERM WORK

1. Reynold's Experiment
2. Verification of Bernoulli's Theorem
3. Orifice meter
4. Venturimeter
5. Rotameter
6. V-notch
7. Pitot-Tube
8. Energy losses due to pipe friction in pipelines
9. Equivalent length of pipe fittings
10. Flow through Packed Bed

D. TEXT BOOKS

1. Gavhane K.A., *Unit Operation-I*; 21st ed.; Nirali Prakashan; Pune, 2011.
2. McCabe, W., Smith, J. *Unit Operations of Chemical Engineering*; 5th ed.; McGraw Hill Incorporation: New York, 2004.

E. REFERENCE BOOKS

1. Badger, W. L., Banchero, J.T., *Introduction to Chemical Engineering*; McGraw Hill Incorporation: New York, 1955.

F. COURSE OUTCOMES

COs	Statement
CO1	Understand the Various Fluid properties and their behaviour.
CO2	Demonstrate the Knowledge of fluid static and dynamics to understand the fluid flow problems.
CO3	Comprehension of fluid flow problems with the application of mass, momentum and energy equations.
CO4	Summarise the performance of the fluid flow operations in industries.
CO5	Classify various instruments relevant to fluid flow operation.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	2	3	3	2	2	2	2	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	2	2	2	2	3	3	3	3
Avg	3	2.6	2.8	2.6	2.8	2.8	2.6	2.6	2.6	2.8	2.6	3	3

DIPLOMA CHEMICAL SEMESTER – IV
SUBJECT: PROCESS CALCULATION (23DK-405)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	1	0	4	60	40	-	-	100

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of Process calculation. Students will learn to develop steady state material and energy balance equations for difference unit operations.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction: - Dimensions & Units, Different systems of units, Conversion of units & simple problems on such topics. Basic Chemical Calculation: - Composition of solids, Liquid mixtures, Ideal gas law, Gas constant, Composition of gaseous mixtures, Dalton's & Amaget's law and simple problems on above topics.	11	CO1
[2]	Material Balance: - Concepts and importance of material balance, Classification of material balance Problems, Problems based on tie material, Inert material balance & simultaneous equation involving various unit operations, Concepts of recycle, purge and bypass. Material Balance with chemical reaction: - Simple steady state material balance problems with chemical reaction.	23	CO2 CO3 CO4 CO5
[3]	Energy Balance: - Forms of energy, Concepts of Cp, Cv, Calculation of enthalpy change, Thermo chemistry involving concepts & simple calculations of H _c , H _R & H _f , Simple energy balance problems.	8	CO2 CO4 CO5
[4]	Combustion: - Types of fuels, calorific value, Simple problems to find out the air requirement & composition of exit gases etc.	4	CO2

C. TEXT BOOKS

1. KA Gavhane, *Unit Operation II*; 3rd ed.; Nirali Prakashan, Pune, July 2017

D. REFERENCE BOOKS

1. Himmelbau. *Basic principles of calculation in chemical engineering*; 5th ed.; New Jersey 1989.

E. COURSE OUTCOMES

COs	Statement
CO1	Understanding different systems units and dimensions.
CO2	Classify of material balance problems, Fuels and Energy.
CO3	Comprehension of material balance equations for difference unit operations.
CO4	Understanding chemical reactions and calculate energy balance and material balance (with chemical reaction).
CO5	Discuss material and energy balance with industrial examples.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	2	3	3	2	2	2	2	3	3	3
CO2	3	3	3	2	2	2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	2	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	3	2.6	2.8	2.6	2.8	2.8	2.8	2.8	2.6	2.8	3	3	3

DIPLOMA CHEMICAL SEMESTER – IV
SUBJECT: MASS TRANSFER - I (23DK-406)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
4	0	3	5.5	60	40	25	50	175

A. COURSE OVERVIEW

The course imparts understanding of fundamental concepts of mass transfer, various mass transfer operations and their equipment's.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Introduction: - Importance of mass transfer operations, classification of mass-transfer operations, methods of conducting mass transfer operations, fundamental design principles.	4	CO1
[2]	Molecular Diffusion Of Fluids: - Concept of molecular and eddy diffusion, Fick's law for diffusion, Steady state molecular diffusion in fluids in laminar flow, simple problems on diffusion by direct use of formula.	6	CO1 CO2
[3]	Interphase Mass Transfer: - Concept of equilibrium, diffusion between phases, mass transfer coefficients, local and average overall mass transfer coefficient, film theory, penetration theory, surface renewal theory, analogy between mass, heat and momentum transfer, concept of stage, stage efficiency, cascade etc.	7	CO1 CO2 CO3
[4]	Gas Absorption: - Definition and application of absorption, equilibrium solubility of gases in liquids, effect of temperature and pressure on solubility, characteristics of ideal liquid solutions of Raoult's law, nonideal liquid solutions of Henry's law, choice of solvent, material balance for the component transfer in counter current and concurrent flow, concept of HETP and simple problems on absorption.	8	CO3 CO5
[5]	Liquid-Liquid Extraction: - Definition and application of liquid extraction, liquid equilibrium for three component system, equilibrium triangular coordinates, system of three liquids one pair partially soluble and system of three liquids two pairs partially soluble, effect of temperature and pressure on the solubility curve, choice of solvents for the operation, simple problems using direct formula.	8	CO3 CO5
[6]	Leaching: - Definition and industrial application of leaching, preparation of solid, temperature of leaching, methods of operations and equipment for in place leaching, heap leaching and percolation tanks, countercurrent multiple contact shanks system, filter-press leaching, agitated vessel, leaching during grinding, equipment like Dorr agitator, Rotocel, Kennedy extractor and Balloman extractor.	8	CO4 CO5
[7]	Equipment For Gas-Liquid Operation: - Construction and working of gas dispersed equipment's like bubble column (Sparged	8	CO4

vessel), agitated vessel, tray tower, mechanically agitated vessels, tray efficiencies, liquid dispersed equipment's like venturi scrubbers, wetted wall column, spray tower, packed tower and comparison between tray and packed tower.		
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C. PRACTICAL AND TERM WORK

- 1 To determine the diffusion coefficient of liquid acetic acid in water. (through diffusion cell)
- 2 To determine the diffusion coefficient of organic vapor in air.
- 3 To determine the diffusion coefficient of Water in air at 50⁰C.
- 4 To determine the mass transfer coefficient for evaluation of liquid H₂O into air under natural convection
- 5 To determine the diffusivity of naphthalene in stagnant air.
- 6 To determine the efficiency of extraction of acetic acid from benzene using water as solvent. (Liquid-Liquid Extraction)
- 7 To find out the stage of each stage in a three-stage leaching operation for [Send- NaOH-H₂O] System

D. TEXTBOOKS

1. Treybal, Robert Ewald. *Mass-Transfer Operations*. New York: McGraw-Hill, 1980.
2. Dr. Kiran D Patil. *Principles and Fundamentals of Mass Transfer Operations-I*. Pune: Nirali Prakashan, 2002.
3. K A Gavhane. *Unit Operations-II (29th Edition)*, Pune: Nirali Prakashan, 2014.

E. REFERENCE BOOKS

1. McCabe, Warren L., and Julian C. Smith. *Unit Operations of Chemical Engineering*. New York: McGraw-Hill, 1967.
2. Walter L. Badger and Julius T. Banchero. *Introduction to Chemical Engineering*. New York: McGraw-Hill, 1955.
3. Richardson, J. F., J. H. Harker, J. R. Backhurst, and J. M. Coulson. *Coulson and Richardson's Chemical Engineering. Vol. 2, Vol. 2*. Oxford: Butterworth-Heinemann, 2002.
4. Perry, Robert H., and Don W. Green. *Perry's Chemical Engineers' Handbook*. New York: McGraw-Hill, 2008.

F. COURSE OUTCOMES

COs	Statement
CO1	Understand mass transfer for same phase as well as different phases and basic principles for design in process industries
CO2	Understand Fick's law and mass transfer coefficient for diffusion in fluids
CO3	Understand theory & analogy for mass transfer and solubility of desired components in solvents
CO4	Demonstrate Equipment's for mass transfer in gas-liquid and solid-liquid phases.
CO5	Demonstrate mass transfer phenomena in gas-liquid, liquid-liquid and solid-liquid phases.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	2	2	2	2	3	3	3	3
CO5	3	3	3	3	3	2	3	2	2	3	3	3	3
Avg	3	3	3	2.8	3	2.6	2.8	2.6	2.6	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – IV
SUBJECT: INSTRUMENTATION (23DK-402)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	0	0	3	60	40	-	-	100

A. COURSE OVERVIEW

This course covers the fundamentals of instrumentation used in industry and apply the key concepts of automatic control and instrumentation to process plants.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction to Instrumentation: - Concept and importance of instrumentation, classification of instruments, basic elements of instruments, characteristics of instruments in detail, brief explanation of first order system and second order system	4	CO1
[2]	Temperature Measuring Devices: - Definition of thermometer, temperature scale, mercury in glass thermometer, Bimetallic & pressure spring thermometers, Principle of thermo electricity, Seebeck effect, Peltier effect & Thomson effect, Industrial thermocouple, lead wire thermowells, Resistance thermometer, Single wheatstone bridge circuit & Null bridge resistance thermometer, Deflection resistance thermometer circuit, Radiation & Optical pyrometers.	12	CO1 CO2
[3]	Measurement of Pressure & Vacuum: - Pressure, Vacuum & Head measuring elements for gauge pressure & Vacuum, indicating elements for pressure gauges, Brief explanation about measurement of absolute pressure, Measuring pressures in corrosive fluids, Static accuracy of pressure gauges, Response of Mechanical Pressure gauges.	12	CO1 CO3
[4]	Measurement of Head & Level: - Head, density & Sp. Gravity, Direct measurement of liquid level, Pressure (Level) measurements in open vessel, level measurement in pressure vessels, Measurement of Interface level, Density measurement, level measurement by weighing, level of dry materials.	12	CO1 CO3
[5]	Process Recording Instruments: - Recording Instruments, Indicating & Signalling Instruments, and Transmission of instrument readings, Control centre, and Instrumentation diagram.	4	CO4
[6]	Distributed Control Systems: - Principle of working, important control modes with simple diagram, Comparison of PLC & DCS system, Principle of modem	4	CO5

C. TEXT BOOKS

1. Ekman D.P., *Industrial Instrumentation*; New Delhi: Wiley Eastern, 1985.

E. COURSE OUTCOMES

COs	Statement
CO1	Understand the importance of Instruments in process industry.
CO2	Demonstrate the mechanical and electrical aspects of instruments used to measure temperature of process.
CO3	Recognize the mechanical and electrical aspects of pressure and level measurement devices and their suitability for process dependent application.
CO4	Understand Recording Instruments and Prepare Instrumentation diagrams.
CO5	Understand the principle, working of PLC and DCS.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	2	3	3	3	3	3	2	2	3	3	3
CO5	3	3	2	3	3	3	3	2	2	2	3	3	3
Avg	3	3	2.6	3	3	3	3	2.8	2.6	2.8	2.8	3	3

DIPLOMA CHEMICAL SEMESTER – IV
SUBJECT: CHEMICAL ENGINEERING EQUIPMENT DRAWING (25DK-412)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
0	0	3	1.5	-	-	25	50	75

A. COURSE OVERVIEW

This course introduces students to the fundamental principles of engineering drawing as applied to chemical process equipment. It covers the interpretation and preparation of process flow diagrams (PFDs), piping and instrumentation diagrams (P&IDs), and technical drawings of chemical engineering equipment such as Pressure vessels

B. COURSE CONTENT

SR. NO.	TOPIC	COS	Hours
1	Symbols of Chemical Engineering Equipment's Refer and draw the standard code/decodes and symbols for Chemical Engineering equipment's. Also create PFD's and diagrams with P&ID controllers.	CO1	9
2	Pressure Vessels To draw and refer diagram of pressure vessel with its key components like shell, Heads/Ends, Nozzles, supports, Manholes etc.	CO2	6
3	Vessel Heads To draw and understand diagrams of various types of pressure vessel heads such as Flat, spherical, Cylindrical and Torispherical/Hemispherical.	CO3	3
4	Vessel Supports Prepare sketches of various types of Vessels supports like Skirt support, Leg supports, Saddle support, Lug support, Ring support etc.	CO4	6
5	Column Internals To discuss, Understand and draw figures of various column internals such as trays (Sieve tray, Valve tray, Bubble Caps), packings, U-tube, Baffles (segmental, Anti-vortex), Support grids, Demister pads, Distributors etc.	CO5	6
6	Heat Exchangers Sketch various types of Heat Exchangers (Shell and Tube, Plate type etc.)	CO2	6

C. TEXTBOOKS

1. Treybal, Robert Ewald. *Mass-Transfer Operations*. New York: McGraw-Hill, 1980.
2. Brownel, L. E.; Young, E. H. *Process Equipment Design & Drawing*; 2nd ed.; WileyEastern Ltd.: New Delhi, 2005

D. REFERENCE BOOKS

1. M. Gopala Rao, Marshall Sittig. *Dryden's Outline of Chemical Technology for 21st Century (3rd Edition)*. East-West Press.
2. McCabe, Warren L., and Julian C. Smith. *Unit Operations of Chemical Engineering*. New York: McGraw-Hill, 1967.
3. Walter L. Badger and Julius T. Banchero. *Introduction to Chemical Engineering*. New York: McGraw-Hill, 1955.
4. *Recommendations on Graphical Symbols for Process Flow Diagram, IS: 3232 – 1965*.

E. COURSE OUTCOMES

COs	Statement
CO1	To draw and understand symbols of chemical engineering equipment's.
CO2	To understand design of Pressure Vessels and its components and draw various types of Heat Exchangers.
CO3	To draw diagrams and understand various types of pressure vessel heads.
CO4	To draw and develop support systems that uphold vessel integrity
CO5	To draw and understand the internal components installed within a pressure vessel to enhance performance

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02
CO1	3	3	2	2	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	2	2	2	3	3
CO3	3	3	3	3	3	3	3	3	3	2	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	3	3	3	3
Avg	3	3	2.8	2.6	3	3	3	3	2.8	2.6	2.6	3	3

SEMESTER-V

Subject	Teaching Scheme (hrs/week)			Total hr	Credit	Examination Scheme				
	L	T	P			Th.	S	P	TW	Total
Mass Transfer – II	4	0	3	7	5.5	60	40	50	25	175
Elements of Thermodynamics & Reaction Engg	3	1	0	4	4	60	40	-	-	100
Petroleum Refining & Petrochemical Technology	3	0	2	5	4	60	40	50	25	175
Fertilizer Technology	3	0	2	5	4	60	40	50	25	175
Polymer Technology	4	0	0	4	4	60	40	-	-	100
Total	17	1	7	25	21.5	300	200	150	75	725

DIPLOMA CHEMICAL SEMESTER – V
SUBJECT: MASS TRSSNFER II (23DK-405)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
4	0	3	5.5	60	40	25	50	175

A. COURSE OVERVIEW

The course is devised to introduce fundamental aspects of Mass Transfer units operations. Students will learn distillation, humidification, drying, crystallization and adsorption unit operation with its industrial application, problem solving knowledge and different equipment that are used in industries.

B. COURSE CONTENT

NO	TOPIC	L+T (Hrs)	COs
[1]	Distillation: - Importance of distillation as separation method, vapor-liquid equilibrium, relative volatility, ideal solutions with Raoult's law, Henry's law, maximum & minimum liquid azeotropes, flash vaporization with material balance calculation, calculations of vapor-liquid equilibrium, Differential distillation with Rayleigh's equation of simple calculation, steam distillation, continuous rectification – binary system based on McCabe & Thiele methods with calculation, Extractive & Azeotropic distillation.	20	C01 C02 C03 C04
[2]	Humidification: - Concept of partial pressure & vapor pressure, definitions & simple calculations for absolute humidity, relative saturation & percentage saturation, concept of wet bulb temperature, dry bulb temperature, dew point, humid volume, humid heat, psychrometric chart, construction & working of different types of cooling tower, spray pond.	08	C01 C02 C05
[3]	Drying: - Applications, understanding of various definitions, types and classification of drying operations, equipments, freeze drying, drying test and derivation of equations for drying time and simple calculations.	12	C01 C02 C03 C05
[4]	Adsorption and Ion Exchange: - Concept and application, types of adsorption, hysteresis, characteristics and nature of adsorbents, effect of temperature, Freundlich equation and its applications for single stage operation, heatless adsorber, major applications and factors affecting ion-exchange.	09	C01 C02 C03 C06
[5]	Crystallization: - Concept and application, methods for supersaturation, classification of crystallizer, Meir's theory, concept of nucleation and crystal growth, effect of seeding and simple calculations for percentage yield, construction and working of Swenson Walker, tank, DTB, Krystal and Vacuum crystallizes.	11	C01 C02 C03 C06

C. PRACTICAL AND TERM WORK

- 1 Simple Distillation
- 2 Tray Drier
- 3 Crystallization of Boric acid with seeding
- 4 Crystallization of Boric acid without seeding
- 5 Adsorption Studies
- 6 Humidity of Air by Using Psychometric Chart
- 7 Types of Dryer (Study Practical)
- 8 Industrial Relevance of Mass Transfer Operation (Study Practical)

D. TEXT BOOKS

1. Treybal, Robert Ewald. *Mass-Transfer Operations*. New York: McGraw-Hill, 1980.
2. Dr. Kiran D Patil. *Principles and Fundamentals of Mass Transfer Operations-I*. Pune: Nirali Prakashan, 2002.
3. K A Gavhane. *Unit Operations-II (29th Edition)*, Pune: Nirali Prakashan, 2014.

E. REFERENCE BOOKS

1. McCabe, Warren L., and Julian C. Smith. *Unit Operations of Chemical Engineering*. New York: McGraw-Hill, 1967.
2. Walter L. Badger and Julius T. Banchero. *Introduction to Chemical Engineering*. New York: McGraw-Hill, 1955.

F. COURSE OUTCOMES

COs	Statement
CO1	To understanding of mass transfer with suitable operations.
CO2	To study the different equipment's used in mass transfer operations with its advantages, Limitations & applications.
CO3	Able to compare and select different mass transfer operations with respective to applications.
CO4	To understanding of VLE data and also calculate theoretical number of trays required in distillation column.
CO5	To understanding of humidification and drying operation with its different terminology.
CO6	Able to understand adsorption, crystallization and ion-exchange operations.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	2	3	3	2	2	2	3	3	3	3
CO2	3	3	3	3	2	2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	3	2.8	3	2.8	2.8	2.8	3	2.8	2.6	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – V
SUBJECT: ELEMENT OF THERMODYNAMICS AND
REACTIONENGINEERING (23DK-512)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	1	0	4	60	40	-	-	100

A. COURSE OVERVIEW

The course imparts fundamentals of thermodynamics and reaction engineering. It introduces chemical engineering thermodynamics theory, thermodynamic properties with their evaluation, it's various applications, reaction kinetics for homogeneous reactions, types of reactors with their performance and their derivations.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction and First law of thermodynamics: - Scope of thermodynamics, Internal energy, the first law of thermodynamics, Thermodynamics State and static function, Enthalpy, The steady state flow process Equilibrium, The phase rule, the reversible process, Constant volume and constant pressure process, Heat capacity.	10	CO1 CO2
[2]	Second law of thermodynamics: - Statement of the second law of thermodynamics, thermodynamics temperature scale, Entropy, Entropy changes of an ideal gas, Mathematical statement of the second law, the third law of the thermodynamics	10	CO2
[3]	Introduction to refrigeration and liquefaction: - The Carnot refrigeration, the vapor compression cycle, Compression of refrigeration cycle, the choice of refrigerant, Adsorption refrigeration, heat pump Liquefaction process	10	CO3
[4]	Introduction to reaction engineering: - Thermodynamics, Chemical kinetics, Classification of reactions, Variable affecting the rate of reaction, Definition of rate.	06	CO1
[5]	Kinetics of homogeneous reaction: - (1) Concentration dependent term of a rate equation: - Single and multiple reaction, Elementary and nonelementary reaction, Kinetic view of equilibrium for elementary reaction, Molecularity and order of reaction, Representation of reaction rate, Testing of kinetic model (2) Temperature dependent term of a rate equation: - Arrhenius law, Collision theory, Transition state theory, Comparison of theory, Comparison of theory with Arrhenius law, Activation energy and temperature dependency, Rate of reaction prediction by the theories (No derivation for all topics)	08	CO1
[6]	Interpretation of batch reactor data: - Constant volume batch reactors, Temperature and rate of reaction, the search of rate equation.	06	CO4
[7]	Introduction to reactor:- Batch reactor; plug flow reactor, continuous stirred tank reactor.	10	CO5

C. TEXTBOOKS

1. K.A. Gavhane., *Chemical Engineering Thermodynamics-I*, Nirali Prakashan.
2. K.A. Gavhane., *Chemical Reaction Engineering-I*, Nirali Prakashan.
3. J.M. Smith, Hendrick Van Ness, Michael Abbott, Mark Swihart., *Introduction to Chemical Engineering Thermodynamics*, McGraw-Hill Education.

D. REFERENCE BOOKS

1. K.V. Narayanan., *A textbook of Chemical Engineering Thermodynamics*. PHI.
2. Octave Levenspiel., *Chemical Reaction Engineering*, John Wiley & Sons, Singapore, 3rd edition, 1998.
3. H.S. Fogler., *Elements of Chemical Reaction Engineering*, Prentice-Hall, NJ, 4th edition, 2006.
4. J. M. Smith., *Chemical Engineering Kinetics*, McGraw Hill, 3rd edition, 1981.

E. COURSE OUTCOMES

COs	Statement
CO1	To understand the basic concepts of thermodynamics, thermodynamic properties and its role, reaction engineering, type of reactions, reaction kinetics, the kinetics of homogeneous reactions, and its related theory.
CO2	To develop the understanding about the fundamental knowledge about laws of thermodynamics and their developed mathematical equations.
CO3	To develop the understanding working of refrigeration and liquefaction cycles/processes.
CO4	To understand interpretation of batch reactor, develop rate expression and role of temperature.
CO5	Enhance the knowledge on types of reactors, working of reactors and developing rate equations.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	2	3	3	3	3	3	3	3	3	3
CO3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	3	3	2.6	2.6	3	2.8	3	3	3	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – V
SUBJECT: PETROLEUM REFINING AND PETROCHEMICAL TECHNOLOGY
(23DK-513)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	0	2	4	60	40	25	50	175

A. COURSE OVERVIEW

To familiarize the students with characteristics of Crude, it's refining to get commercially important fractions and products. To help the students in understanding the unit operations and unit processes in manufacture of various petrochemicals and their downstream products.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Origin, Formation & Composition of Petroleum: - Origin & formation of petroleum, Reserves & deposit of world, Indian petroleum refineries with their location & capacity, composition of petroleum.	5	CO1
[2]	Petroleum Processing Data: - Classification of crude oil, Crude Assay Analysis, ASTM Distillation, Thermal properties of petroleum	10	CO1 CO2
[3]	Fractionation of Petroleum: - Dehydration & Desalting of crude, pipe still heaters, Distillation of crude oil, Important products, properties & test methods, additives for various petroleum products.	10	CO1 CO3
[4]	Treatment Techniques: - Physical & Chemical Impurities, Treatment of gasoline, Kerosene & lubes by various methods. Removal of sulfur and sulfur compound.	10	CO4
[5]	Thermal & Catalytic Processes: - Objective of cracking & Reforming operations, effect of temperature & pressure on cracking, advantages of cracking, Reforming & Platforming.	10	CO6
[6]	Introduction of Petrochemical Industry: - Definition, History, Major Petrochemical products and their producers in India, Raw materials for Petrochemicals, Characteristics of Petrochemical Industry.	5	CO1
[7]	Manufacture of C₁ compound: - Manufacture of Methanol, Formaldehyde. Manufacture of C₂ compound: - Ethylene & Polyethylene, Vinyl chloride, Ethanol, Ethylene di-chloride, Ethylene oxide. Manufacturing of C₃ compound: - Propylene & Polypropylene, Cumene, Acrylonitrile, Manufacture of C₄ Compound: - Butadiene, Iso butylene, Butanol, Aromatics Chemicals: - Styrene LAB, Phenol, Terphthalic Acid & DMT, Phthalic anhydride and Malaik anhydride	10	CO5

C. PRACTICAL AND TERM WORK

1. Study of ASTM Distillation.
2. Determination of the flash point and fire point of given petroleum sample using Pensky Marten's apparatus.
3. Determination of the flash point and fire point of given petroleum sample using Able's apparatus.
4. To determine the aniline point of given petroleum sample using Aniline point Apparatus.
5. To determine Smoke point of given petroleum Sample.
6. Determination of Kinematic viscosity of given petroleum sample using Redwood Viscometer.
7. To determine the Softening Point of given sample.
8. To determine Cloud point and Pour Point of given sample.
9. To Study the Proximate Analysis of given coal sample.
10. To determine the Penetration Number of given sample.

D. TEXT BOOKS

1. Bhaskara Rao, B.K., *Modern Petroleum Refining Processes*, 6th Ed. Oxford & Ibh, New Delhi, 2017.
2. Bhaskara Rao, B.K., *A Text on Petro Chemicals*, 5th Ed, Khanna Publisher, New Delhi, 2010.

E. REFERENCE BOOKS

1. G.N. Sarkar, *Advanced Petroleum Refining*; Khanna Publishers: New York, 1955.

F. COURSE OUTCOMES

COs	Statement
CO1	Understand the basics of Petroleum Crude and Petrochemical products and its composition.
CO2	Explain the knowledge of different refining processes.
CO3	Understand the Properties and Implement the Test methods of Petroleum Products.
CO4	Examine the different Treatment Process for Petroleum Products.
CO5	Develop the production processes of various Petrochemical products.
CO6	Understand Cracking and Reforming operation and explain different processes for cracking and reforming operation.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	2	2	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	2	3	3	3	3
CO6	3	3	3	3	3	3	3	2	2	3	3	3	3
Avg	3	3	3	3	3	3	3	2.5	2.5	3	2.8	3	3

DIPLOMA CHEMICAL SEMESTER – V
SUBJECT: FERTILIZER TECHNOLOGY (23DK-514)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
3	0	2	4	60	40	25	50	175

A. COURSE OVERVIEW

To inculcate the knowledge of various processes and operations of the chemical industries, among the diploma students of chemical engineering.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction: - Need of fertilizer, type of fertilizer, merits and demerits of fertilizer, fertilizer industries at glance.	5	CO1
[2]	Nitrogenous fertilizer: - Roll of Nitrogenous fertilizer, sources and properties of hydrogen, nitrogen and ammonia, manufacture of synthesis gas by steam hydrocarbon, reforming and partial oxidation methods, synthesis of ammonia, types of converters, storage and handling of ammonia. A. Urea: properties and uses, manufacture of urea by total recycle process with Montecatini and Toyokotsu process. B. Ammonium nitrate: properties, manufacturing process and uses. C. Ammonium sulfate: properties, manufacturing processes and uses. D Ammonium chloride properties, manufacturing processes and uses	10	CO2
[3]	Potassium fertilizer: - Roll of potassium as fertilizer, properties, and sources of potash and production of KCl.	10	CO3
[4]	Phosphatic fertilizer: - Roll of Phosphorus as fertilizer, types of rock phosphate, production of elemental phosphorus (yellow or red) manufacture. of phosphoric acid by wet method, electric arc furnace method, production of normal and super triple phosphate, ammonium phosphate, major engineering problem of such industries.	10	CO4
[5]	Mixed fertilizer: - Manufacture and granulation of mixed fertilizer and bulk blending.	10	CO6
[6]	Environmental aspects of fertilizer industry: - Brief idea about air pollution, methods of controlling the air pollution and effluent treatment for fertilizer industries.	5	CO5

C. PRACTICAL AND TERM WORK

- 1 Estimation of percentage of Nitrogen & Ammonia in a given sample of Ammonium chloride (NH₄Cl) by substitution method.
- 2 To determine the strength of given concentrated sulphuric acid.
- 3 To determine percentage of moisture from urea by dean and stark method.
- 4 Estimation of percentage of Nitrogen & Ammonia in a given sample of Ammonium sulphate [(NH₄)₂SO₄] by substitution method.

- 5 To determine the strength of given concentrated hydrochloric acid.
- 6 To find out percentage of N_2 and NH_3 in given sample of fertilizer $(NH_4)_2SO_4$ by back titration method.
- 7 To find out percentage of N_2 and NH_3 in given sample of fertilizer (NH_4Cl) by back titration method.
- 8 To make the study of manufacturing process of Urea with process flow diagram.
- 9 To make the study of manufacturing process of Ammonium sulphate from gypsum with process flow diagram.
- 10 To make the study of manufacturing process of NSP and TSP with process flow diagram

D. TEXT BOOKS

1. Dryden's Outlines of Chemical Technology, 2nd Ed. By M. Gopala Rao & Marshall Sittig, East West Press Pvt. Ltd., New Delhi.

E. REFERENCE BOOKS

1. Shreve's Chemical Process Industries, 5th Ed. By, George F. Austin McGraw Hill International Edition.

F. COURSE OUTCOMES

COs	Statement
CO1	To use relevant fertilizer on the basis of different properties to improve fertility of soil.
CO2	Analyse the roll of nitrogen and flow of raw materials to finished products in process flow diagrams of nitrogenous fertilizer industries and to understand the various associated engineering problems.
CO3	Identify process flow diagrams of potassium fertilizer industries and to understand the various associated engineering problems.
CO4	Explaining the production processes of Phosphorus Fertilizer products.
CO5	Create awareness among students for the research and innovation in the field of Fertilizer industries for environmental issues and sustainability.
CO6	To understand manufacturing of mixed fertilizer and calculate different grade of fertilizer.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	2	2	2	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	2	3	3	3	3
CO6	3	3	3	2	3	3	3	3	3	2	2	3	3
Avg	3	3	3	2.8	2.6	3	3	2.6	2.6	2.6	2.5	3	3

DIPLOMA CHEMICAL SEMESTER – V
SUBJECT: POLYMER TECHNOLOGIES (23DK-517)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
4	0	0	4	60	40	-	-	100

A. COURSE OVERVIEW

The course is introducing general concept of polymer & polymerization techniques. Students will learn to what is polymerizations and their productions methods, classifications of polymerization techniques. And also to gain the knowledge of chemistry of polymerization, plastics, fibers, rubbers, Resins for Adhesives and Protective Coating, Fiber and Film, Polymer processing etc....

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction to polymers: - Brief history, About polymers, Classification of polymers according to 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, glass transition temperature.	5	CO1 CO2
[2]	Chemistry of Polymerisation: - Introduction, Chain polymerisation – Free radical polymerisation, Ionic polymerisation, Introduction to catalytic polymerisation, Step polymerization.	7	CO1 CO2
[3]	Polymerization Techniques: - Bulk polymerisation, Solution polymerisation, Suspension polymerisation, Emulsion polymerisation, Melt polycondensation, Solution Polycondensation, Interfacial polymerization	6	CO2 CO3
[4]	Plastics: - Introduction, Classification of Plastics, Raw Materials, Preparation, properties, and applications for the Addition Polymerization Products like Poly Ethylene, LDPE, HDPE, PVC, Poly Styrene, Alloys, blends, and composites, Engineering Plastics like Nylon, ABS, Poly Carbonates, TEFLON etc, Recent trends in plastics like bio degradable plastics etc.	5	CO1 CO4 CO5
[5]	Rubbers: - Introduction and classification of rubber, vulcanization, reinforcement with carbon black, Natural rubber, Preparation, properties, and applications of synthetic rubbers like SBR, Poly Butadiene, Poly Ethylene- Propylene & Butyl Rubber, Brief of some important rubber like Nitrile rubber, Neoprene, Reclaim Rubber.	10	CO1 CO4 CO5
[6]	Resins for Adhesives and Protective Coating: - Introduction, Condensation polymerization products like Phenol Formaldehyde (Phenolic Resins), Amino Resins, Polyester Resins, Alkyl Resins and Epoxy Resins, Polyurethane Resins, Poly Amide Resins	10	CO1 CO4 CO5

[7]	Fiber and Film: - Introduction to fiber, Properties of fiber, Cellulosic fiber: Viscose Rayon and Cellulose Acetate, Polyamide fibers, Polyester fiber, Acrylic fibers, carbon fibers, Films: Viscose & Cellulose Acetate, Poly olefins, Poly Vinyl Chloride	10	C01 C05 C04
[8]	Polymer processing: - Extrusion, injection molding, compression molding, blow molding, film extrusion, spinning, extrusion film blowing, etc.	7	C01 C03

C. TEXT BOOKS

1. V R Gowarikar, Polymer Science, 6th edition, New Delhi 1986.
2. R Sinha, Outlines of polymer Technology, Esten Economy Edition, New Delhi, 2000.

D. REFERENCE BOOKS

1. Fred W Billmeyer Jr, Text Book of Polymer Science, 3rd edition, New York, 1984.

E. COURSE OUTCOMES

COs	Statement
C01	To Remembering of general introduction of polymers, polymerizations, polymerizations techniques, Rubbers, Plastics, Resins, Fibers and film, polymers processing.
C02	To Remembering of types of polymers, polymerizations, polymerisation techniques, Rubbers, plastics.
C03	To Understanding of polymerization techniques & polymer processing.
C04	To Analyse different applications of polymerizations products like Rubbers, Plastics, Resins, Fibers & Films.
C05	To Remembering of properties of Plastics, Fibers & Films.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	2	2	2	3	2	2	2	3	2	3	2	3	3
C02	3	3	3	2	2	3	3	3	2	3	2	3	3
C03	3	3	3	3	3	3	3	3	3	3	3	3	3
C04	3	3	3	3	3	3	3	3	3	3	3	3	3
C05	2	2	2	2	2.5	2	3	3	2.5	3	2.5	3	3
Avg	2.8	2.6	2.6	2.6	2.5	2.6	2.8	3	2.5	3	2.5	3	3

SEMESTER-VI

Subject	Teaching Scheme (hrs/week)			Total	Credit	Examination Scheme				
	L	T	P			hr	Th.	S	P	TW
Industrial Training/Projects	0	0	30	30	15	-	-	100	50	150
Seminar	0	0	6	6	3	-	-	-	50	50
Total	0	0	36	36	18	0	0	100	100	200

DIPLOMA CHEMICAL SEMESTER – VI
SUBJECT: INDUSTRIAL TRAINING / PROJECT WORK (23DK-601)

Teaching Scheme, Hr/Week			Credits	Examination Scheme (Marks)				Total
L	T	P		Ext.	Int.	TW	P	
0	0	30	15	-	-	50	100	150

A. COURSE OVERVIEW

A student will undergo in-plant training for about 16 weeks and submit a training report which covers following aspects or he will prepare a complete project report comprising product properties, various manufacturing processes, process selection, material balance energy balance, plant location and layout etc. under the guidance of concerned faculty.

B. COURSE CONTENT

NO	TOPIC
[1]	Factory Organizations: Operation, Supporting, Engineering Services, Plant Location, Layout, Waste management, Utility Supply.
[2]	Operation of Chemical Plant: Key activities, Technology absorption, Process control, Safety Awareness/Emergency Handling, Troubleshooting, and In-process Quality Control.
[3]	Construction/Working/Operation/Inspection of Pipes/Pipe fittings, Instruments, Distillation Tower, Filtration, Centrifuges, Heat Exchanger, Evaporator, Drier, Cooling Towers, Pumps etc.
[4]	Concept of Startup / Shutdown / Emergency handling / Maintenance etc.