

THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA, POLYTECHNIC, (FACULTY OF TECHNOLOGY & ENGINEERING) VADODARA-390002

TEACHING AND EXAMINATION SCHEME FOR 6 SEMESTER (3 YEARS) DIPLOMA IN PETROCHEMICAL TECHNOLOGY

(Implemented from 2021-22 progressively)

Subject Code	Deptt. Code	Subject	Teaching Scheme (hrs per week)			Examination				Total Marks	Grade
			Th.	Pract./ Tutorial	Total	Theory		Pract TW&Viva			
						Hr.	Marks	Hr.	Marks		
FIRST SEM OF FIRST YEAR (PCT)											
ENG 3106	ENG	Communication Skill I	2	--	2	2	50	--	--	50	2
AMT 3109	MATH	Applied Mathematics - I	4	1	5	3	100	2	**25	125	5
APH 3106	PHY	Applied Physics - I	2	2	4	2	50	--	--	50	3
ACH 3109	CHEM	Applied Chemistry - I	2	2	4	2	50	--	--	50	3
MEC 3108	ME	Engineering Drawing - I	3	4	7	3	100	--	*25	125	5
APM 3103	AM	Engineering Mechanics - I	3	2	5	3	100	--	*25	125	4
MEC 3110 L	ME	Workshop Practice - I	--	2	2	--	--	3	**50	50	1
		Total	16	13	29		450		125	575	23
SECOND SEM OF FIRST YEAR (PCT)											
ENG 3207	ENG	Communication Skill II	2	--	2	2	50	--	--	50	2
AMT 3211	MATH	Applied Mathematics - II	4	1	5	3	100	2	**25	125	5
APH 3203	PHY	Applied Physics - II	2	2	4	2	50	2	50	100	3
ACH 3206	CHEM	Applied Chemistry - II	4	4	8	3	100	3	50	150	6
MEC 3221	ME	Elem. of Mech. Engg.	3	2	5	3	100	3	50	150	4
APM 3205	AM	Engineering Mechanics - II	3	2	5	3	100	--	*25	125	4
MEC 3217L	ME	Workshop Practice - II	--	2	2	--	--	3	50	50	1
		Total	18	13	31		500		250	750	25
FIRST SEM OF SECOND YEAR (PCT)											
CHL 3310 L	PCT	Basic Computer Practice	--	2	2	--	--	3	**25	25	1
CHL 3311	PCT	Chem. Engg. Materials	4	2	6	3	100	3	**25	125	5
ACH 3303	CHEM	Organic Chemistry	4	3	7	3	100	3.5	50	150	5.5
ELE 3323	EE	Elect Engg & Electronics	4	2	6	3	100	3	50	150	5
CHL 3312	PCT	Mechanical Operation	4	3	7	3	100	3.5	50	150	5.5
CHL 3313	PCT	Chemical Process Industries	4	2	6	3	100	3.5	50	150	5
		Total	20	14	34		500		250	750	27
SECOND SEM OF SECOND YEAR (PCT)											

CHL 3413	PCT	Process Calculation	4	2	6	3	100	3	50	150	6
CHL 3414	PCT	Petroleum Refining Engineering	4	2	6	3	100	3.5	50	150	5
CHL 3409	CHEM	Phy. & Analytical Chem.	4	3	7	3	100	3.5	50	150	5.5
CHL 3415	PCT	Fluid Flow Operation	4	2	6	3	100	3.5	50	150	5
CHL 3416	PCT	Mass Transfer Operation - I	4	3	7	3	100	3.5	50	150	5.5
		Total	20	12	32		500		250	750	27
FIRST SEM OF FINAL YEAR (PCT)											
CHL 3515	PCT	Heat Transfer Operation	4	3	7	3	100	3.5	50	150	5.5
CHL 3516	PCT	Plant Operations	4	--	4	3	100	--	--	100	4
CHL 3517	PCT	Chem. Engg. Thermodynamics	4	2	6	3	100	3.5	50	150	6
CHL 3518	PCT	Mass Transfer Operation - II	4	3	7	3	100	3.5	50	150	5.5
CHL 3519 L	PCT	Chemical Engineering Computation	--	2	2	--	--	3.5	**50	50	1
CHL 3520	PCT	Petrochemical Technology	4	0	4	3	100			100	4
CHL 3514 L	PCT	Project Work - I	--	2	2	--	--	3.5	**50	50	1
		Total	20	12	32		500		250	750	27
SECOND SEM OF FINAL YEAR (PCT)											
CHL 3620	PCT	Entrepreneurship Dev. & Mgt.	4	--	4	3	100	--	--	100	4
CHL 3614 L	PCT	Chem. Engg. Drawing	--	3	3	--	--	3.5	**50	50	1.5
CHL 3621	PCT	Health Safety & Env.	4	2	6	3	100	3.5	**50	150	5
CHL 3622	PCT	Polymers Tech. & Proc.	4	2	6	3	100	3.5	50	150	5
CHL 3623	PCT	Process Instrumentation & Control	4	2	6	3	100	3.5	50	150	5
CHL 3624	PCT	Chemical Reaction Engineering	3	2	5	3	100	3.5	50	150	4
CHL 3619 L	PCT	Project Work - II #	--	2	2	--	--	3.5	**100	100	1
		Total	19	13	32		500		350	850	25.5

* TW Only

** TW incl. Viva

Include plant visit

		The Maharaja Sayajirao University of Baroda Polytechnic Department of Petrochemical Technology Polytechnic, Near Shastri Bridge, Fatehgunj, Vadodara-2 0265-2781983, , www.msubaroda.ac.in		ACADEMIC YEAR 2015-2016	
Diploma : Full Time (Regular)					
Year	I	Applied Chemistry- I		UA	50
Semester	I			Hours	28
Course Content / Syllabus					
UNIT-I	Fundamental Chemistry				4 hrs.
	Symbols, Formula, Valency, Chemical equations Mole, Molecular weight Equivalent weight, concentration of solution, Types of chemical equations & calculation on basis of chemical equations				
UNIT-II	Atomic structure and classification of elements				4 hrs.
	Discovery of nucleus, Rutherford's atomic model, Bohr's theory fundamental, particle, atomic number, Isotopes, Isobar, Binding energy, Electronic arrangement in atoms sub energy level, atomic Orbitals, Aufbau's principles, Electron arrangement in Orbitals, Chemical Bonding, Classification of elements, Modern periodic law. Long form of Periodic table, Lanthanides and actinides				
UNIT-III	Ionisation & Electrolysis				4 hrs.
	Theory of ionization, Modern concept of acids & Bases indicators, Solubility product, Common ion Effect, Electrolysis, Faradays laws of electrolysis, Industrial applications of electrolysis, Ionic product of water, PH scale, Buffer solutions.				
UNIT-IV	Chemical Equilibrium and laws of mass action				4 hrs.
	Reversible reactions, Equilibrium law mass action & Its expression. Active mass exothermic & endothermic reactions, Lechatelier's Principle & its Application				
UNIT-V	Water & its treatment				4 hrs.
	Impurities in water, Soft and hard water. Types of Hardness, effect of impurities, Formation of scale, Priming and forming, treatment of boiler feed Water, potable water, degree of hardness, estimation Of hardness				
UNIT-VI	Metallurgy				3 hrs.
	General principle of chemical metallurgy, Ore dressing, calcination, roasting, extraction of metals from concentrated ore, Metallurgy of copper, Aluminium and Zinc				
UNIT-VII	Production of steel from Iron				3 hrs.
	Variation of Iron , Manufacture of steel, Classification of Steel, carbon Steel, Stainless steel, Effect of impurities on steel , Heat treatment of Steel.				
UNIT-VIII	Alloys				2 hrs.
	Objectives of alloying , properties of alloys , classification of alloy, Approximate composition and application of Nickel Steel, chrome steel, chrome Nickel Steel, Bronze, Brass , Bell metal , Gun Metal, Monel metal, German silver solder , Pewter type metal , Duralmin , Bearing metal				
References					
1.	Polytechnic Chemistry by V.P.Mehta				
2.	A text book of Engineering chemistry by M.M.Uppal				

3.	Inorganic chemistry by P.L.Soni
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Diploma : Full Time (Regular)					
YEAR	I	Applied Mathematics – I		UA	100
Semester	I				
COURSE CONTENT / SYLLABUS					
UNIT-I		Reorientation Surds-Definition, Operation and rationalization (Revision) Logarithm-Change of Base Rule and Examples. Binominal Theorem – (for integral power) Partial fractions Quadratic Equations: Nature of roots of quadratic equations Progressions: Arithmetic (Revision and Geometric progressions Determinants Equation of second and third order determinants, Properties, solution of simultaneous linear equations in two and three unknowns, Consistency condition Matrices Definition and operation, Transpose, adjoint and Inverse of a matrix, solution of simultaneous linear equations in two and three unknowns. Complex Numbers Definition, operation, properties, Cartesian and polar forms, De’ movies theorem and its application.			
UNIT-II		Limits, continuity(functions of one variable)			
UNIT-III		Differentiation and Partial Differentiation			
		Differentiation Definition of derivative, differentiation of standard function by first principle, Rule of Differentiation, Differentiation of algebraic, trigonometric, Exponential, Logarithmic, Implicit functions and Composite functions, Higher order derivatives, Leibnitz’s Theorem Partial Differentiation Functions of two variables, Definition of partial derivatives, Euler’s Theorem, Implicit functions and Differentials, Applications (Approximations, Maxima and Minima)			
UNIT-IV		Straight line Inclination and slope of a line, different forms of equations to a straight line (i) Slope-intercept form (ii) Point-slope form (iii) Two-point form (iv) Intercept form. General equation of a Straight line, Family of lines. Conditions for concurrency of lines. Circle Definition, Equation of a circle with given center and radius, General form of equation of circle, Equation of a circle when intercepts are given, circle passing through three points, Equation of chord, Equations of tangents and normal at a point on a circle.			
UNIT-V		Reorientation (Trigonometric functions as circular functions)			

	Addition and Factor formula, Trigonometric functions of multiple and submultiples angles.
UNIT-VI	Properties of Triangle
	Sin formula, Cosine formula, Projection formula, Napier's analogy, Half-Angle formulae
REFERENCES	
1.	Polytechnic Mathematics (Made Easy) (Applied Mathematics) By Manjeet Singh
2.	Mathematics for Polytechnic students By S. P. Deshpande

		The Maharaja Sayajirao University of Baroda Polytechnic Department of Petrochemical Technology Polytechnic, Near Shastri Bridge, Fatehgunj, Vadodara-2 0265-2781983, , www.msubaroda.ac.in		ACADEMIC YEAR 2015-2016	
Diploma : Full Time (Regular)					
YEAR	I	Applied Physics – I		UA	50
Semester	I			HOURS	25
COURSE CONTENT / SYLLABUS					
UNIT-I	MEASUREMENTS				3 hrs.
	Fundamental and derived units, Various System of Units, Errors in Measurement: Instrumental, Personal, Random error, Estimation of errors: (Average absolute error, Relative or fractional error, percentage error), Combination of errors, Significant figures: Significant digits in addition, subtraction, multiplication and division. Introduction to scalar and Vector quantities				
UNIT-II	ELECTRICITY AND MAGNETISM				8 hrs.
	Static electricity : Coulomb’s Law, Electric field, Electric flux and flux density, Electric field due to a point charge, Electric field due to an electric dipole, Gauss’s Law, Electric potential and potential due to a point charge, Potential due to an electric dipole. Capacitor and Capacitance, Energy stored in a capacitor, Parallel plate capacitor, Capacitors in series and parallel Current Electricity: Ohm’s Law, Resistance and Resistivity, Resistance in series and Parallel, Effect of temperature on resistance, Kirchoff’s Laws, Whetstone’s Bridge, Shunt, conversion of galvanometer to Ammeter and Voltmeter, Revision of Heating effect of electric current, Seebach and peltier effects, Thermocouple and thermopile Magnetism: Force between the magnetic poles, Definition of Magnetic field, Intensity of magnetization, Magnetic induction, Magnetic susceptibility, Magnetic Permeability, Para, dia and ferromagnetic substances				
UNIT-III	MAGNETIC EFFECT OF ELECTRIC CURRENT				7 hrs.
	Magnetic field due to a current carrying conductor, Biot-savart’s law, Magnetic field at the center of circular coil, Force on a current carrying conductor, Fleming’s rule, Tangent Galvanometer, Force on a Charged particle in magnetic field, Measurement of e/m. Electromagnetic induction, Faraday’s laws, Induced emf in a conductor, Lenz’s law, Inductors and inductance, Inductance of solenoids, Self and Mutual inductance				
UNIT-IV	LIGHT				4 hrs.

	Laws of Reflection, Properties of image formed by plane mirrors, Spherical Mirrors: Definitions, Mirror formula for concave mirror and magnification, Laws of refraction, Refraction through prism and prism formula, Refraction through lenses, Lens formula for convex lens, Equivalent focal length of two convex lenses, Total internal Reflection. Light as a wave, Interference at light, Young's experiment, Definition of Coherent sources and path difference, Analytical treatment at Interference, Theory of Interference fringes, Diffraction of Light, Diffraction by a single slit, Introduction to Polarization of Light, Uses of polarization	
UNIT-V	FIBER OPTICS	3 hrs.
	Structure of optical fiber, Type of optical fibers, Characteristics & Properties of Optical fiber, Applications of optical fiber	
REFERENCES		
1.	Engg. Physics by R.K. Gaur and S.I. Gupta Published by Dhanpat Rai & Sons	
2.	Principles of Physics by N. Subramanyam and Brijlal	
3.	Applied physics for diploma courses by G.G.Umrani	

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Diploma : Full Time (Regular)					
YEAR	I	Communication Skill I		UA	50
Semester	I			Hours	
COURSE CONTENT / SYLLABUS					
UNIT-I	Comprehension				
	Technical English General English				
UNIT-II	Letter Writing				
	Job Application Letter of Order Letter of Complaint Letter of Recommendation Letter of Invitation Letter to friends and relatives				
UNIT-III	Word formation				
	Affixation – Prefix, Suffix Conversion – Verb to Noun Noun to Verb Adjective to Noun Noun to Adjective Adjective to Verb Compounding – Noun Compounds Adjective Compounds Verb Compounds				
UNIT-IV	Grammar				
	Articles Prepositions Verbs, Tenses Adjectives				
UNIT-V	Oral Presentation				
UNIT-VI	Memorandum, Short Notices/Messages				
REFERENCES					
1.	English Communication (2 nd Edition) Technical Teachers Training Institute, Madras , Oxford Universities Press, 2005, (Rs. 42)				
2.	Macmillan Grammar : A Handbook – A.E. Augustine & K.V. Joseph (Macmillan)(Rs. 98)				
3.	Communication Skills for Technical Students – T.M. Farhathullah (Orient Longman, 2002, (Rs. 175)				
4.	Learning English : A Communicative Approach – Orient Longman , 2006, (Rs. 140)				
5.	Written Communication in English- Sarah Freeman, Orient Longman, 1977 (Rs. 75)				

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Diploma : Full Time (Regular)					
YEAR	I	Engineering Drawing – I		UA	100
Semester	I			HOURS	44
COURSE CONTENT / SYLLABUS					
UNIT-I	Introduction to Engg. Drawing language				3 hrs.
UNIT-II	Locus of points				5 hrs.
UNIT-III	Engineering curves like ellipse, parabola involute				5 hrs.
UNIT-IV	Orthographic projection				6 hrs.
UNIT-V	Sectional orthographic projection				6 hrs.
UNIT-VI	Isometric projection				6 hrs.
UNIT-VII	Free hand sketches of different types of joints Rivetted joints, cotter joints, coupling. Leak proof joints, pipe joints, screw threads				6 hrs.
UNIT-VIII	Development of surfaces				7 hrs.
REFERENCES					
1.	Engineering Drawing by N. D. Bhatt				
2.	Machine drawing by N. D. Bhatt				

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Diploma : Full Time (Regular)					
Year	I	Engineering Mechanics – I		UA	100
Semester	I			HOURS	42
COURSE CONTENT / SYLLABUS					
UNIT-I	Fundamental of Applied Mechanics				2 hrs.
	Fundamental unit, Derived units, system of Units, scalar & vector quantities, introduction to applied mechanics.				
UNIT-II	Force				3 hrs.
	Force characteristics of force, system of forces, fundamental principles of transmissibility effect of force				
UNIT-III	Coupling concurrent force system				7 hrs.
	Resultant & equilibrant force, Equilibrium of a Coplanar concurrent force system, Analytical Method, parallelogram & Lamis theorems Composition and resolution of forces. Bow's Notation Graphical method laws of parallelogram, Triangle & polygon of force				
UNIT-IV	Moment & couple				6 hrs.
	Moment, Types of moment, couple & characteristic of couple Varignon's theorem of moment. Conditions of equilibrium for coplanar non-concurrent forces				
UNIT-V	Coplanar non-concurrent forces				6 hrs.
	Parallel force system, resultant of parallel force , System by Graphical & analytical method, Resultant of coplanar non concurrent & non parallel forces by analytical method & graphical Method				
UNIT-VI	Support reaction				6 hrs.
	Types of supports, types of loads, support reaction by graphical and analytical method for simply Supported beam, over hanging beam and roller And hinged beams Reaction of perfect frame				
UNIT-VII	Centroid				6 hrs.
	Centre of gravity & moment of inertia Centre of gravity, centroid of composite geometrical Figures, centre of gravity of solid body, modules of selection, moment of inertia radius of gyration, theorem of parallel axis, moment of inertia radius of gyration, theorem of parallel axis, moment of inertia of rectangle, triangle, circle, symmetrical I section & II sections				
UNIT-VIII	Friction				6 hrs.
	Static, dynamic, & limiting friction Rolling & sliding friction, normal reaction, coefficient of friction, angle of friction and angle of repose laws of friction. Friction along various plane ladder friction wedge friction & screw jack friction				
REFERENCES					
1.	Applied Mechanics Vol. I & II Sunil S.Deo – Nirali Publication				
2.	Engg. Mechanics – R.S.Khurmi – S.Chand & company				
3.	Applied Mechanics Static & dynamics - S.B.Junnurkar &H.J.Shah				
4.	Applied Mechanics Vol.I & II by Shri R.C.Patel & Shri B.M.Patel				

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Diploma : Full Time (Regular)					
Year	I	Applied Chemistry- II		UA	100
Semester	II			Hours	56
Course Content / Syllabus					
UNIT-I	Chemical bonding				5 hrs.
	Introduction, covalent bond, Bond Capacity of C,H,N,O,Cl,S,& Si, Bond polarity valence bond theory Hybridization, Hydrogen bond, Vander Walls forces of attraction				
UNIT-II	Periodic table & periodic properties				5 hrs.
	The long form of periodic table Periodic properties of elements Types of elements, Electron negativity				
UNIT-III	Preparation of standard solution				4 hrs.
	Define the term solute, solvent, solution Methods of expressing concentration Weight/Weight method, Weight/volume method Types of W/W method, explain molarity, PPM, mole, fraction, Types of W/V methods, gms/lit Normality Molarity, Formality, PPM for aqueous solution Problems on above calculations, % solution				
UNIT-IV	Catalyst & Catalysis				5 hrs.
	Definition, Characteristics of catalyst, Types of Catalysis classification of catalyst, Catalysis promoters, Inhibitors, Autocatalysis, Theories of catalysis, Intermediate compound formation, Theory Modern adsorption theory, Use of catalysis in different industrial products				
UNIT-V	Inert gases				4 hrs.
	Method of separation of inert gases, compound of inert gases and their application				
UNIT-VI	Phase rule				5 hrs.
	Homogeneous & Hetrogenous system, The phase rule, Phases, components, Degree of freedom, partition coefficient, Application to one component system water, sulphur, & two component system				
UNIT-VII	Introduction to Organic Chemistry				8 hrs.
	Purification of Organic Compounds, Detection & estimation of Elements C,H, N, Halogen, S & P. Empirical & molecular formula				
UNIT-VIII	Nomenclature				6 hrs.
	IUPAC System of Nomenclature Organic Compounds and their types, Classification of Organic compounds according to their functional Group & structure, IUPAC , naming rules Application of IUPAC system in naming of the Organic Compound				
UNIT-IX	Aliphatic Compounds				14 hrs
	Chemical reaction & method of preparation, Properties & uses of important aliphatic Compounds. Alkane , Alkene , Alkyne , Monohydric alcohols, preparation properties and applications				
References					
1.	Inorganic chemistry by P.L.Soni				
2.	Physical Chemistry by Bhal & Tuli				

3.	Text book of Organic chemistry by P.L.Soni
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Diploma : Full Time (Regular)					
YEAR	I	Applied Mathematics – II		UA	100
Semester	I				
COURSE CONTENT / SYLLABUS					
UNIT-I	Application of derivatives				
	Geometrical interpretation of the derivative, Tangent and Normals, Angle between two curves sub- tangent and sub-normal. Maxima and Minima, Rectilinear Motion, Approximate value, Radius of Curvature.				
UNIT-II	Indefinite integrals				
	Standard formulae, Integration by substitution, Integration by Algebraic function, Integration by parts, Trigonometric substitutions. Integration by the method of partial fractions.				
UNIT-III	Definite Integration				
	Definite Integrals: Definition, Definite Integrals as the limit of a sum. Properties of definite integrals				
UNIT-IV	Application of Integration				
	Area, Volume, Approximate integrations, Simpson's rule Trapezoidal rule, Moment of Inertia, Center of gravity, Pappus, Theorem. Length of Arc Surface areas				
UNIT-V	Differential Equations				
	Formation of differential equations. Separation of variables, Equations reducible to separation of variables, Homogeneous differential equations, Equations reducible to homogeneous, Linear Differential Equation, Equation Reducible to linear form, Exact Differential Equation				
UNIT-VI	Vector Algebra				
	Interdiction, Addition of Vectors, Properties of Addition of Vectors, Subtraction of a vector, Multiplication of a vector by scalar, position vector, Product of two Vectors, scalar or dot product. Work done as a scalar product, vector product of cross product. Scalar triple product				
REFERENCES					
1.	Polytechnic Mathematics (Made Easy) (Applied Mathematics) By Manjeet singh				
2.	Mathematics for polytechnic students By S.P.Deshpande				
3.	Elementary Engineering Mathematics By B.S.Grewal				

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Diploma : Full Time (Regular)					
YEAR	I	Applied Physics – II		UA	50
Semester	II			HOURS	28
COURSE CONTENT / SYLLABUS					
UNIT-I	GRAVITATION				4 hrs.
	Newton’s Law of Gravitation. Gravitation near the surface of earth. Non uniformity of density of earth, shape of earth, Rotation of earth. Variation in ‘g’ with altitude and depth, Definition of Gravitational field and Escape velocity. Planets and satellites: kepler’s Laws, Orbital velocity, Geostationary and polar satellites, Uses of Artificial satellites.				
UNIT-II	FLUID				5 hrs.
	Definitions: Fluid, Density, Specific Gravity, Pressure. Fluids at rest ($P = P_0 + \rho gh$). Measuring pressure: The mercury barometer, Pascal’s Principle and Archimedes Principle, Floatation, Apparent weight in a fluid. Fluids in Motion, types of flow, Equation of Continuity & Bernoulli’s theorem, Application of Bernoulli’s theorem (Description). Viscosity & Coefficient of Viscosity. Stoke’s law & Expression for terminal velocity				
UNIT-III	THERMAL PHYSICS				6 hrs.
	Heat: Concept of heat and temperature, Thermometric scales and their inter-conversions, Specific heat and thermal capacity, Change of state: fusion and latent heat of fusion, Vaporization and latent heat of vaporization, Gas laws – Boyle’s law, Carle’s law, and Gay Lussac’s law, Concept of absolute zero, General gas equation, Specific heat of gases, Work done during expansion of gas at constant pressure, Relation between C_p & C_v . Thermodynamics :Thermal equilibrium, Zeroth law of thermodynamics, Phase diagram, First law of thermodynamics, Thermodynamics processes, Heat engine and its efficiency Heat transfer: Thermal conduction, Thermal conductivity and coefficient of thermal conductivity				
UNIT-IV	SOUND				5 hrs.

	Periodic motion and simple Harmonic motion, Equation of SHM, Velocity and acceleration in SHM, Concept of Wave motion. Definitions: Amplitude, Periodic time, frequency, wavelength, wave velocity. Longitudinal and transverse waves, Equation of Plane progressive wave, Free and forced oscillations, Resonance, Vibrations of Air columns, Velocity of sound by resonance tube method, Newton's and Laplace's formula for velocity of sound, Effect of temperature, Pressure and humidity on velocity of sound, Loudness and intensity of sound, Acoustics: echo, reverberation, requirement of satisfactory acoustics, Ultrasonic Waves and its properties, Applications of ultrasonic waves	
UNIT-V	MODERN PHYSICS Quantum theory: Black body radiation, Planck's hypothesis and concept of quantum radiation, Photoelectric effect:- Einstein Equation, Application of photoelectric cell. X-rays:- Production of X – rays, Properties and application of X – rays. Lasers:- Spontaneous emission and stimulated emission, Population inversion, Applications of lasers. Classification of solids: Energy levels in solids, Valence band, Conduction band, forbidden band, Intrinsic and Extrinsic Semiconductors, PN diode, Characteristics of a diode. Nuclear science: Discovery of Radioactivity, Definition and units of radioactivity, Types of radiations and their biological effects, Natural and Artificial Radioactivity, Half life, Mean life, Binding energy, Nuclear reactions and types of nuclear reactions, Nuclear reactor, Radio isotopes and their uses.	8 hrs.
REFERENCES		
1.	Engg. Physics by R.K. Gaur and S.I. Gupta Published by Dhanpat Rai & Sons	
2.	Principles of Physics by N. Subramanyam and Brijlal	
3.	Applied physics for diploma courses by G.G.Umrani	

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Diploma : Full Time (Regular)					
YEAR	I	Communication Skill II		UA	50
Semester	II			Hours	
COURSE CONTENT / SYLLABUS					
UNIT-I	Note Taking				
	- Identifying important information in spoken and written texts - Use of sentences linkers, cohesive devices - Using Abbreviations, Charts, Diagrams and Symbols, Graphs, Tables				
UNIT-II	Paragraph writing				
	- Sentence Linkers and supporting sentences - Identification and organization of paragraphs types - Guided compositions				
UNIT-III	Report Writing				
	- Technical Reports – Reporting a workshop job - Writing an investigative report				
UNIT-IV	Grammar				
	- Voice - Degrees of comparison - Framing questions - Question tags - Negative sentences - Spelling errors				
UNIT-V	Precise writing				
UNIT-VI	Group Discussion				
REFERENCES					
1.	English Communication (2 nd Edition) Technical Teachers Training Institute, Madras , Oxford Universities Press, 2005, (Rs. 42)				
2.	Macmillan Grammar : A Handbook – A.E. Augustine & K.V. Joseph (Macmillan)(Rs. 98)				
3.	Communication Skills for Technical Students – T.M. Farhathullah (Orient Longman, 2002, (Rs. 175)				
4.	Learning English : A Communicative Approach – Orient Longman , 2006, (Rs. 140)				
5.	Written Communication in English- Sarah Freeman, Orient Longman, 1977 (Rs. 75)				

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Diploma : Full Time (Regular)					
YEAR	I	Element of Mechanical Engineering		UA	100
Semester	II			HOURS	
COURSE CONTENT / SYLLABUS					
UNIT-I	Power transmission systems				
	Introduction Types of power transmission system, Characteristics of power transmission system, Mechanical drives comparison of various, Mechanical drives.				
UNIT-II	Belt & rope drives				
	Construction, specification, selection, Application of Belts, V Belts, Rope & Pulley Open & cross belt drives velocity ratio, slip, Methods of minimizing slip, Ratio of tension in the belt, V Belt, Rope drives, Initial tension centrifugal tension, HP transmitted, Belt speed, simple problems based on Belt & rope drives.				
UNIT-III	Chain drives				
	Types of chain their selection, Application Constructional feature of roller & silent chains & sprockets, kinematics of chains				
UNIT-IV	Clutches				
	Constructional features of single plate, Multiplate cone and centrifugal clutches.				
UNIT-V	Fly Wheels				
	Function of Fly wheels, Uses of Fly wheels				
UNIT-VI	Couplings				
	Sleeve or muffle coupling, Flange coupling , Marine type coupling, Flexible coupling, Hook coupling, Selection & application of coupling				
UNIT-VII	Brake				
	Introduction, types of brake, Calculation of braking torque				
UNIT-VIII	Gear drives				
	Introduction, classification of gears Gear terminology & application, calculation of centre distance, no. of teeth speed ratio for simple gears, compound reverted and epicyclic, gear trains. Construction of single and multistage gear boxes for various types of gear.				
UNIT-IX	I.C. Engine				
	classification of IC engine, two strokes four stroke engine explanation of IHP, BHP machine				
UNIT-X	Boilers & steam engine				
	Classification of boilers, high pressure modern boiler. Accessories & mountings of boiler of steam engine & their components, economizer.				
UNIT-XI	Steam turbine				
	classification of steam turbine, construction and Working of impulse & reaction steam turbine, steam nozzles				
UNIT-XII	Mechanical seals				
REFERENCES					
1.	Elements of Mechanical Engg. by Prof. R.C. Patel				
2.	Heat Engine by Shah and Pandya				
3.	Technical Dynamics by Prof. R.C. Patel				

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Diploma : Full Time (Regular)					
YEAR	I	Engineering Mechanics - II		UA	100
Semester	II			HOURS	42
COURSE CONTENT / SYLLABUS					
UNIT-I	Linear and angular motion Mechanics, Dynamics, Kinetics and Kinematics Rectilinear motion displacement, speed velocity, acceleration, equation of Linear action with uniform acceleration, Velocity time diagram angular motion, Rotation, angular displacement angular velocity, angular acceleration, relation between linear and angular motion, equation of angular motion with uniform acceleration.				6 hrs.
UNIT-II	Force Mass Acceleration and work power energy, types of energy, Newton's laws of motion, Relation between force, mass acceleration. Definition of work power, energy, types of energy, conservation of energy.				6 hrs.
UNIT-III	Lifting machines and power transmission Law, definitions, Mechanical advantage, velocity ratio, efficiency, Law of machine, friction in the machine, Maximum efficiency and reversibility machine, some types of lifting machine such as inclined plane, simple wheel and axle, wheel and differential axle, worm and worm wheel and screw jack and their velocity ratio, power transmission, individual drive an drop group drive belt and pulley drive, driver, follower and idler, cross and belt, transmission belt, slips and its consideration, centrifugal tensile gear transmission various types of gear used, gear transmission.				7 hrs.
UNIT-IV	Simple stress and strain and elastic constants, elasticity stress, strain, types of stress, working stress, Factor of safety. Young's Modulus of elasticity. Deformation of body due to forces acting on it. Principles of superposition stress in bars of varying action and bars of composite section stress due to change in temperature. Linear and lateral strain, Poission's ratio volumetric strain, Bulk modulus. Modulus of rigidity Relation between E.G.K.				7 hrs.
UNIT-V	Bending Moment, shear force and bending stress Definition of bending moment and shear force. S.F. & B.M. diagram cantilever and simply supported beams loaded with point load and U.D.L. point of contraflexure theory of simple bending, assumptions in the theory of simple bending. Bending stress equation. $\frac{M}{I} = \frac{F}{Y} = \frac{E}{R}$ Neutral axis moment of resistance, Distribution of bending stresses in symmetrical and unsymmetrical section.				8 hrs.
UNIT-VI	Thin cylindrical and spherical shells. Thin cylindrical and spherical shells, stress in cylindrical stress, design of cylindrical shell change in dimension of cylindrical shell due to internal pressure, thin spherical shell, change in the diameter and volume of thin spherical shell due to internal pressure.				5 hrs.
UNIT-VII	Torsion – shafts subjected to Torsion – Deisgn of simple couplings.				3 hrs.

REFERENCES	
1.	Applied Mechanics and strength of material by Shri R.S. Khurmi
2.	Applied Mechanics by Shri V.G. Dadhe
3.	Applied Mechanics by Shri S.B. Junnarkar
4.	Applied Mechanics Vol.I & III by Shri R.C. Patel & Shri B.M. Patel.
5.	Mechanics of structures Vol. I by Shri S.B. Junnarkar

Syllabus of FIRST SEMESTER SYD PCT

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: Diploma in Petrochemical Technology

Programme Specific Outcome (PSO)

PSO1 : To apply the understanding and knowledge of basic sciences, engineering, laboratory skills, tools, and methodologies to provide appropriate solutions in the field of chemical and process industries.

PSO2 : To develop professional approach in managing production, operations, maintenance, and design of safe and sustainable chemical processes.



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**ACADEMIC
YEAR
(2022-2023)**

Diploma in Petrochemical Technology: Full Time (Regular)

Year	II	CHL 3310 L: Basic Computer Practice	Max. Marks	IA	-
				UA	50
Semester	I	Core / Elective / Foundation	Hours per week		2
			Credits		-

Mode of Transaction : Laboratory (2P)

Prerequisite : Applied Mathematics, Communication skill

Course Outcome (CO): CHL 3310L

- CO1** Discuss the fundamentals of a computer system and its operations.
- CO2** Describe the details of the operating system and terminologies used.
- CO3** Comprehend the interface with the input and output devices.
- CO4** Apply the essentials of MS Word, MS EXCEL, and MS PowerPoint in real-life scenarios.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Lev el	CO	PSO	Eleme nts of Employ ability (Emp.) / Entrepr eneursh ip (Ent.) / Skill Develop ment (SD)	Releva nce to Local (L) / Nationa l (N) / Regiona l (R) / Global (G)	Relati on to Gender (G) / Environ ment and Sustaina bility (ES) / Human Values (HV) / Professi onal Ethics (PE)
1.	Introduction to Computers Introduction of Computer, Benefit of Computer System, Hardware & Software, Uses of Computers	4	14	1,2	CO1, CO3	PS01	Emp., SD	G	PE
2.	Computer System Major Components of a computer System, Input Devices, Output Devices, Storage Devices, Computer System configuration	6	22	1,2	CO2, CO3	PS01	Emp., SD	G	PE
3.	MS-Word Formatting Text and Paragraphs, Managing Lists (sorting and formatting of list), Adding Tables, Inserting Graphic Objects, Controlling Page Appearance (page borders, headers, footers etc.), Preparing to Publish a Document (Check Spelling, Grammar, and Readability), assignment on writing reports, different formats of files (.pdf, .doc, .pps etc)	6	22	1,2,3	CO4	PS01, PS02	Emp., SD	G	PE
4.	MS – Excel Introduction to Excel, Concept of Sheet and Workbook, Basic Excel, Sort & Filter, Basic Formulas and Functions, Creating Charts, function library.	7	24	1,2,3	CO4	PS01, PS02	Emp., SD	G	PE

5.	MS PowerPoint Introduction to MS PowerPoint, Creating Slides via Templates, Wizard, Blank Slide, Insert Menu, Changing Background of a Presentation, Building a Presentation, Slide Show, Various Tabs and Options	5	18	1,2,3	CO4	PS01, PS02	Emp.,SD	G	PE
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REFERENCES

1.	Mukesh Sharma, "Basic Computer Course: A Freshers Guide to Modern Day Computing", Abhishek Publication, 2013
2.	Rajaraman V, Adabala N, "Fundamentals of Computers", Prentice Hall India, 2013
3.	Michael Miller, "Computer Basics: Absolute Beginner's Guide", 8 th Ed, QUE, 2015

Year	II	CHL 3310 L: Basic Computer Practice (Practical including Viva)	Hours per week	2
			Credits	1
Semester	I	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	Introduction to computer	CHL 3310L	1, 2, 3	CO1, CO2, CO3 CO4	PS01, PS02
2	Mail Merge				
3	M.S. Excel				
4	M.S. Word				
5	M.S. Power Point				
6	Spread Sheet				
7	Use of Short cut keys				



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**ACADEMIC
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(2022-2023)**

Diploma in Petrochemical Technology: Full Time (Regular)

Year	II	CHL 3311: Chemical Engineering Materials	Max. Marks	IA	20
				UA	80
Semester	I	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures and Laboratory (4L+2P)

Prerequisite : Basic concept of chemistry, physics, mathematics

Course Outcome (CO): CHL 3311

- CO1** Concept of Engineering Materials, properties & their application
- CO2** Ferrous and Non- Ferrous alloys, their applications & forming techniques
- CO3** Corrosion: Concept, testing theories and its prevention methods
- CO4** Ceramic, Polymer, Lubricants, Cement , Coating and Composites, their composition & application
- CO5** Application and Selection of Special materials: Insulation, Packaging, Adhesives

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp.) / Entrepreneurship (Ent.) / Skill Development (SD)	Relevance to Local (L) / National (N) / Regional (R) / Global (G)	Relation to Gender (G) / Environment and Sustainability (ES) / Human Values (HV) / Professional Ethics (PE)
1.	Engineering materials Definition, classification, fundamental nature and Scope of engineering materials, Engineering properties of materials, Factors affecting properties of materials	6	11	1,2	CO1, CO3, CO4	PSO1, PSO2	Emp., SD	G	PE
2.	Metal and Alloys: Types of Furnaces, Iron- Carbon structure and phase diagram, Objective, classification and properties of alloying, Ferrous alloys, Alloys of Aluminium, copper, nickel, zinc, lead. Welding, soldering, and brazing.	10	18	1,2,3	CO2	PSO1	Emp., SD	G	PE
3.	Corrosion & its prevention Definition, Theories of corrosion, Types of corrosion, methods for protection against corrosion, Laboratory & Plant corrosion test for selection of materials	8	14	1,2,3	CO3	PSO1	Emp., SD	G	PE
4.	Ceramic materials: Types, compositions & application of ceramic materials Cement – properties, composition & application of Cement	5	9	1,2,3	CO1	PSO1, PSO2	Emp., SD	G	PE

5.	Polymer materials Polymer: Definition, Types and uses of polymers, Introduction to methods of polymerisation, Rubber: Classification and properties of rubber	7	12	1,2,3	CO1	PSO1, PSO2	Emp., SD	G	PE
6.	Organic protective coatings Paints: classification, ingredients, properties and types of paints Varnishes - classification, ingredients, properties and types of varnishes.	6	11	1,2,3	CO1, CO4	PSO1, PSO2	Emp., SD	G	PE
7.	Lubricants: classification, properties and application of lubricants and methods of applying lubricants	5	9	1,2,3	CO1, CO4	PSO1, PSO2	Emp., SD	G	PE
8.	Special application materials Insulation: materials properties & application of Insulation materials. Adhesives- classification of Adhesives, advantages & limitation of Adhesives. Packaging materials: Objectives of packaging, requirement of Packaging materials, Properties, uses and types of packaging material	9	16	1,2,3	CO1, CO3, CO4	PSO1, PSO2	Emp., SD	G	PE

REFERENCES

1.	Rangwala, "Engineering Materials: Material Science", Charotar Publishing House, 2011
2.	V. K. Manchanda, G. B. S. Narang, "Materials and Metallurgy", Khanna Publishers, 1996
3.	R K Rajput, "Engineering Materials", S Chand & Company, 2000
4.	Raghavan V, "Materials Science and Engineering: A First Course", Prentice Hall, 2015

Year	II	CHL 3311 L: Chemical Engineering Materials (Practical including Viva)	Hours per week	2
			Credits	1
Semester	I	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	To observe the phenomenon of passivity in iron- nitric acid system.	CHL 3311	2, 3	CO1, CO3, CO5	PSO1, PSO 2
2	To study the corrosion chart (Metal selection guide).				
3	To measure total dissolved salts in water by TDS Meter				
4	To find melting point of the given substance				
5	To determine the specific gravity of the given substances				
6	To study material safety datasheet				
7	To carry out electroplating of copper on SS plate using sulphate bath				
8	Anodizing of aluminium in sulphuric acid bath.				
9	To study Metallurgical Microscope.				



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**ACADEMIC
YEAR
(2022-2023)**

Diploma in Petrochemical Technology: Full Time (Regular)

Year	II	CHL 3313: Chemical Process Industries	Max. Marks	IA	20
				UA	80
Semester	I	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures and Laboratory (4L + 2P)

Prerequisite : Basic Concept of Chemistry, Physics, Mathematics

Course Outcome (CO): CHL 3313

- CO1** Explain unit operations and unit processes to draw process flow diagram (PFD)
- CO2** Outline the industries and products based on the types, processes, and grades.
- CO3** Describe the manufacturing process in chemical process industries and list the major engineering challenges in production of chemicals.
- CO4** Discuss the types of fertilizers with comparison of different process technologies.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Lev el	CO	PSO	Eleme nts of Employ ability (Emp.) / Entrepr eneursh ip (Ent.) / Skill Develop ment (SD)	Releva nce to Local (L) / Nationa l (N) / Regiona l (R) / Global (G)	Relati on to Gender (G) / Environ ment and Sustaina bility (ES) / Human Values (HV) / Professi onal Ethics (PE)
1.	Introduction Concept of chemical industries Flow diagrams & symbols used in flow Diagram	2	4	1,3	CO1, CO3	PSO1	Emp., SD	G	PE
2.	Inorganic chemical industries Manufacturing of sulphuric acid, Nitric acid, Hydrochloric acid, Phosphoric acid, their raw Material, properties.	5	9	1,2,3	CO2, CO3	PSO1, PSO2	Emp., SD	G	PE
3.	Caustic soda & chlor alkali industries Manufacturing of caustic soda, soda ash, & Chlorine.	4	7	1,2,3	CO2, CO3	PSO1, PSO2	Emp., SD	G	PE
4.	Industrial gases Manufacturing of industrial fuel gases, water gas, producer gas, with properties & application	4	7	1,2,3	CO2, CO3	PSO1, PSO2	Emp., SD	G	PE
5.	Natural product industries Manufacturing of soap, detergent, constituents of Oil and fats	4	7	1,2,3	CO2, CO3	PSO1, PSO2	Emp., SD	G	PE

6.	Carbohydrate & fermentation industry Extraction of sugar cane for crystalline sugar Production, starch, ethyl alcohol by fermentation.	4	7	1,2,3	CO ₂ , CO ₃	PSO ₁ , PSO ₂	Emp., SD	G	PE
7.	Pulp and paper industry Pulp sulphite & sulphate pulp process, Manufacturing of paper.	4	7	1,2,3	CO ₂ , CO ₃	PSO ₁ , PSO ₂	Emp., SD	G	PE
8.	Miscellaneous industries Pharmaceutical Industry: Types of drugs, Classification of drugs, flowsheet of penicillin G, Acetyl salicylic acid etc. Dyes & intermediates: Raw materials, uses, classification of dyes Agrochemicals: Pesticides, Weedicides, Plant growth stimulator etc.	10	18	1,2,3	CO ₂ , CO ₃	PSO ₁ , PSO ₂	Emp., SD	G	PE
9.	Introduction to Fertilizers: Essential nutrients and its importance for plants, Need of fertilizer, Types and classification of fertilizers, Merits and Demerits of fertilizers.	4	7	1,2	CO ₄	PSO ₁ , PSO ₂	Emp., SD	G	PE
10.	Process Technologies for chemical and compound fertilizers Nitrogenous fertilizers, Phosphatic Fertilizers and Potash fertilizers (Urea, Ammonium Nitrate, Ammonium Sulphate, Nitro phosphate, Super Phosphate, Potassium Chloride, Potassium Sulphate etc.)	11	20	1,2,3	CO ₄	PSO ₁ , PSO ₂	Emp., SD	G	PE

11.	Bio Fertilizers Introduction, need and classification of bio fertilizers, General production method, Method of application, Carrier material and its selection, Caution, and limitation of bio fertilizers.	4	7	1,2,3	CO4	PSO1, PSO2	Emp., SD	G	PE
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REFERENCES	
1.	C. E. Dryden, "Outlines of Chemical Technology", Affiliated East-West Press, 1973
2.	R. N. Shreve, G. T. Austin, "Chemical Process Industries", McGraw-Hill, 1984
3.	"Fertilizer Manual", UN Industrial Development Organization, Int'l Fertilizer Development Centre Springer Netherlands, 2010

Year	II	CHL 3313 L: Chemical Process Industries (Practical including Viva)	Hours per week	2
			Credits	1
Semester	I	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	To prepare 250 ml of 0.1N NaOH solution and standardize it with 0.1N oxalic acid solution.	CHL3 313	2, 3		
2	To prepare 250 ml of 0.1N HCl solution and standardize it with 0.1N NaOH solution.				
3	Determine the ammoniacal nitrogen content in given sample of fertilizer by Formalin method.				
4	Determine the ammoniacal nitrogen content in given sample of NH ₄ NO ₃ fertilizer by Formalin method.				

5	Determine the phosphorus content in given fertilizer sample by Gravimetry method.			CO2,CO3, CO4	PS01, PS02
6	Determine % K ₂ O in given sample of fertilizer.				
7	To prepare soap				
8	To prepare boric acid				
9	To prepare alum				
10	Determine the ammoniacal nitrogen content in given fertilizer sample by Kjeldahl's distillation method.				

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Diploma in Petrochemical Technology: Full Time (Regular)					
Year	II	CHL 3312: Mechanical Operations	Max. Marks	IA	20
				UA	80
Semester	I	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction	:	Lectures and Laboratory (4L + 3P)
Prerequisite	:	Basic concept of chemistry, physics, mathematics

Course Outcome (CO): CHL 3312

- C01** Discuss the concept of unit operation and unit processes like size reduction, conveying, sedimentation, filtration, agitation, mixing and conveying with their objectives and equipments.
- C02** Compare methods to characterize solid particles and solid separation techniques.
- C03** Compute problems related to capacity, power, efficiency for equipments used for mechanical operation.
- C04** Select relevant mechanical operations and equipments for different chemical processes.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Lev el	CO	PSO	Elem ents of Empl oyabi lity (Emp .) / Entre prene urshi p (Ent.) / Skill Devel opme nt (SD)	Rele vanc e to Local (L) / Natio nal (N) / Regio nal (R) / Globa l (G)	Rela tion to Gende r (G) / Envir onme nt and Sustai nabilit y (ES) / Huma n Value s (HV) / Profes sional Ethics (PE)
1.	Introduction Definition of unit operation & unit process, Difference of unit operation & unit process with examples.	2	4	1	CO1	PSO1	Emp., SD	G	PE

2.	Properties of particulate solid Characterisation of solid particles (size, shape, and size distribution), techniques to find Particle size	2	4	1,2	CO2	PSO1	Emp., SD	G	PE
3.	Screen Analysis screening equipment's, screening analysis methods, capacity, and effectiveness of screen	4	7	1,2,3	CO2	PSO1	Emp., SD	G	PE
4.	Size reduction and enlargement a) Comminution: principle of comminution, energy and power requirement in comminution, laws of crushing, calculation of power requirement by crushing laws b) Size reduction equipment: Types, construction, working, merits and demerits of crushers, grinders and ultrafine grinders, selection criteria for size reduction equipment's c) size enlargement: principle and uses of size enlargement.	11	20	2,3	CO1, CO3, CO4	PSO1, PSO2	Emp., SD	G	PE
5.	Agitation Definition of agitation, equipment for agitation, Purposes of agitation, Types of impellers, equation for power consumption in agitation, flow Patterns in agitated tanks, Baffles, Vortex prevention, Factors affecting agitation, Calculation of power consumption in Agitated vessels.	7	12	2,3	CO1, CO3, CO4	PSO1, PSO2	Emp., SD	G	PE
6.	Mixing of powder and pastes Principle, construction, working and uses of mixing equipment's used for solid, mixing index, factors affecting selection of mixer.	4	7	2,3	CO1, CO3, CO4	PSO1, PSO2	Emp., SD	G	PE

7.	Filtration Principle of filtration, constant rate and constant pressure filtration, types of filters (batch and continuous), filter media, filter aids	10	18	2,3	CO1, CO3, CO4	PSO1, PSO2	Emp., SD	G	PE
8.	Sedimentation Batch sedimentation, rate of Sedimentation, principle of centrifugal sedimentation, thickeners and clarifiers, Free & Hindered Settling	7	12	2,3	CO1	PSO1, PSO2	Emp., SD	G	PE
9.	Separation based on property (solid particles) Definition & application of solid separation, different equipment used for separation of solid based on different properties, Factors affecting selection of equipment for solid separation	5	9	1,2,3	CO2	PSO1, PSO2			
10.	Conveying of solids (Conveyors) Definition of conveying, types and uses of conveyors	4	7	1,2,3	CO1	PSO1, PSO2			

REFERENCES

1.	W.L. Mc Cabe, J.C. Smith, P.Harriot 'Unit Operations of Chemical Engineering' 7th Ed. McGraw Hill, 2006.
2.	J.M. Coulson & J.F. Richardson 'Chemical Engineering' Vol.- II, 6th Ed. Elsevier, 2003
3.	Unit operations – I : Fluid flow and Mechanical operations by K.A.Gavhane.

Year	II	CHL 3312 L: Mechanical Operations	Hours per week	3
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		(Practical including Viva)	Credits	1.5
Semester	I	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	To determine the viscosity of given oil using terminal settling velocity equation applicable in stokes law range.	CHL 3312	2, 3	CO1, CO2, CO4	PSO1, PSO2
2	Ball mill To determine (a) Critical speed (b) Observed optimum speed (c) Specific surface created (of product) (d) Observed critical speed of the ball mill				
3	To determine the sedimentation characteristics of given calcium carbonate slurry.				
4	Roll Crusher To determine (a) Angle of nip (b) Theoretical capacity (c) Ribbon factor(d) Power required for crushing and reduction rate of roll crusher				
5	To study the operation of filter press in the laboratory				
6	Cumulative Analysis				
7	To determine (a) Volume surface mean diameter (b) Specific surface of mixture (c) No. of particles in the mixture (particle population)				
8	To find the power consumption of the given agitator and hence plot the graph of Power No. (N _P) v/s Reynolds No. (N _{Re})				
9	To determine individual and overall efficiency of cyclone separator.				

SECOND SEMESTER SYD PCT

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: Diploma in Petrochemical Technology

Programme Specific Outcome (PSO)

- PSO1** : To apply the understanding and knowledge of basic sciences, engineering, laboratory skills, tools, and methodologies to provide appropriate solutions in the field of chemical and process industries.
- PSO2** : To develop professional approach in managing production, operations, maintenance, and design of safe and sustainable chemical processes.



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**ACADEMIC
YEAR
(2022-2023)**

Diploma in Petrochemical Technology: Full Time (Regular)

Year	II	CHL 3415: Fluid Flow Operation	Max. Marks	IA	20
				UA	80
Semester	II	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures and Laboratory (4L + 2P)

Prerequisite : Applied Mathematics and Applied Science

Course Outcome (CO): CHL 3415

- CO1** Discuss the concepts of fluid flow, fluid flow phenomena, differentiate between types of flow with key theories.
- CO2** Apply and solve fluid flow equations, including Bernoulli's equation, continuity equation, and Euler's equation etc., to analyse fluid flow problems.
- CO3** Apply fluid statics principles to solve problems related to pressure, hydrostatic equilibrium, and manometer calculations.
- CO4** Use of Fluid moving and flow measurement devices to calculate flow rates.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Lev el	CO	PSO	Element s of Employab ility (Emp.) / Entrepre neurship (Ent.) / Skill Developm ent (SD)	Rele vanc e to Local (L) / Natio nal (N) / Regio nal (R) / Globa l (G)	Relati on to Gender (G) / Environ ment and Sustaina bility (ES) / Human Values (HV) / Professi onal Ethics (PE)
6.	Fluid static & its applications Nature of Fluid, Types of fluid, pressure concept, Hydrostatic equilibrium, Barometric equation, Types of fluids, Types of Manometers, Calculation of pressure drop in manometer	9	17	1,2	CO1, CO3	PSO1, PSO2	Emp., SD	G	PE
7.	Fluid flow phenomena Potential flow, Laminar flow & Turbulent flow, Newtonian and non-Newtonian fluids and their Examples, viscosity of gases and liquid, Boundary layer separation & Wake formation.	6	11	2,3	CO1	PSO1, PSO2	Emp., SD	G	PE
8.	Basic equations of fluid flow Mass velocity, Average velocity, Bernoulli's equation, Kinetic energy correction, correction for fluid friction and pump work in Bernoulli's equation, calculations to find power requirement by pump in flow system	7	12	1,2,3	CO1, CO2	PSO1, PSO2	Emp., SD	G	PE
9.	Flow of incompressible fluids in pipes Flow of Incompressible fluid in pipes, Hagen Poiseuille equation, friction factor chart, effect of roughness, friction losses, Calculations to find head losses in given flow system.	7	12	2,3	CO1, CO2	PSO1, PSO2	Emp., SD	G	PE

10.	Flow measurement Types, construction, working, advantages and disadvantages of Variable head meter and variable area meter, pitot tube, examples based on calculation of flowrate in flowmeters.	7	12	1,2,3	CO4	PSO1, PSO2	Emp., SD	G	PE
11.	Transportation of fluids Pipes, tubes, types of pipe fittings, types of valves, leakage prevention devices.	8	14	1,2,3	CO4	PSO1, PSO2	Emp., SD	G	PE
12.	Fluid moving machinery. a) Pumps: Centrifugal pump -principle, construction, working of pump, characteristic curve of centrifugal pump, advantages, and disadvantages of pump, Cavitation & NPSH, simple calculation of power requirement in C.F. pump. Positive displacement Pumps - classification, uses, merits and demerits of different positive displacement pumps. b) Fans, Blowers & Compressors – Description & uses	12	22	1,2,3	CO4	PSO1, PSO2	Emp., SD	G	PE

REFERENCES

1.	W. McCabe, J. Smith, P. Harriott, "Unit Operations of Chemical Engineering", McGraw-Hill Education, 2005
2.	J.M. Coulson & J.F. Richardson 'Chemical Engineering' Vol. I, 6th Ed, Elsevier, 2004.
3.	R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Revised 9th Ed, Laxmi Publications, 2010
4.	Unit Operations – I [Fluid Flow and Mechanical Operations] By KA Gavhane.

Year	II	CHL 3415 L: Fluid Flow Operation (Practical including Viva)	Hours per week	2
			Credits	1
Semester	II	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	Determine discharge coefficient of V notch.	CHL 3410 L	2, 3	CO1, CO3, CO4	PSO1, PSO2
2	Determine the discharge coefficient for the Venturi meter.				
3	Determine the Fanning friction factor.				
4	To observe the type of flow in a pipe & hence determine the Reynold's number.				
5	To verify Bernoulli's theorem using Bernoulli's apparatus.				
6	Determine the discharge coefficient for the Orifice meter.				
7	Determine the performance characteristics of centrifugal pump.				
8	To verify Ergun's equation and relation between the superficial velocity and pressure drop length to packing.				
9	Determine pipe the resistance offered by pipe fittings & express them in terms of pipe diameter and velocity head.				
10	To study the velocity distribution in the pipe & hence estimate the ratio of average velocity to maximum velocity at the centre of pipe and flow rate.				



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**ACADEMIC
YEAR
(2022-2023)**

Diploma in Petrochemical Technology: Full Time (Regular)

Year	II	CHL 3416: Mass Transfer Operation-I	Max. Marks	IA	20
				UA	80
Semester	II	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures and Laboratory (4L + 3P)

Prerequisite : Applied Science, Chemical Process Industries, Fluid flow operation,

Course Outcome (CO): CHL 3416

- C01** Discuss the concept of mass transfer, laws and related theories.
- C02** Compare different mass transfer operations, its selection and application.
- C03** Apply basic design steps for Absorber and Stripper.
- C04** Discuss gas dispersed and liquid dispersed equipment.
- C05** Use psychometric calculations and curve for humidification operation.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Lev el	CO	PSO	Elem ents of Empl oyabi lity (Emp .) / Entre prene urshi p (Ent.) / Skill Devel opme nt (SD)	Rele vanc e to Local (L) / Natio nal (N) / Regio nal (R) / Globa l (G)	Rela tion to Gende r (G) / Envir onme nt and Sustai nabilit y (ES) / Huma n Value s (HV) / Profes sional Ethics (PE)
1.	Introduction Introduction and Classification of Mass transfer Operation, selection of separation method, Methods of conducting the Mass transfer operation, Factors affecting mass transfer operation.	6	11	1,2	CO1, CO3	PSO1	Emp., SD	G	PE
2.	Molecular diffusion in fluids Fick's Law, Types of diffusion, Steady State Molecular diffusion in Gases, liquids and solids, Estimation of diffusivity of gases and liquids, Application of Molecular diffusion.	8	14	1,2,3	CO1	PSO1	Emp., SD	G	PE
3.	Mass transfer Co-efficient's Types of Mass transfer coefficient (local and overall), Relation between Mass transfer co-efficients, significance and conclusion of penetration theory, film theory, surface renewal theory. Corresponding dimensionless groups related to Mass & Heat transfer.	6	11	1,2	CO1	PSO1	Emp., SD	G	PE

4.	Inter Phase Mass Transfer Equilibrium & Equilibrium distribution curve, diffusion between phases, relation between local & overall M.T. coefficient, material balance on Steady State Cocurrent and counter current process, define stage, ideal stage, theoretical stage, Stage efficiency, cascade.	8	14	2,3	CO1, CO3	PSO1, PSO2	Emp., SD	G	PE
5.	Equipment for gas liquid operation (a) Gas dispersed equipment: agitated vessels, tray/sieve tower, Operating characteristic of sieve tray, Types and sketch of different trays, Tray arrangements, tray efficiency. b) Liquid dispersed equipment: Venturi scrubbers, wetted wall towers, spray tower & spray chambers, packed towers, types and sketch of different packings, Packing arrangement, Characteristics of packing,	8	14	1,2,3	CO4	PSO2	Emp., SD	G	PE
6.	Humidification Operation Definition of various terms uses of Clausis clapeyron equation to calculate vapour pressure, vapour pressure curve, psychrometric chart for Air water System, Types and operation of water-Cooling tower, spray pond, spray chamber.	8	14	1,2,5	CO1, CO5	PSO1, PSO2	Emp., SD	G	PE
7.	Absorption & Stripping. Definition of absorption & desorption, use of Solubility and equilibrium solubility curves (two Component system only) effect of operation parameter on solubility, characteristics of ideal-non ideal solution, Raoult's Law, Henry's law, Selection of solvent for absorption, material balance on counter current & cocurrent absorber & Stripper. Define – HETP, HTU, NTU, Absorption factor and stripping factor.	12	22	1,2,3	CO2, CO3	PSO1, PSO2	Emp., SD	G	PE

REFERENCES

1.	R. E. Treybal, "Mass-Transfer Operations", McGraw-Hill, 1988
2.	W.L. McCabe, J.C. Smith, P. Harriot, "Unit Operations of Chemical Engineering", 7 th Ed, McGraw-Hill, 2006
3.	J.M. Coulson & J.F. Richardson, "Chemical Engineering", Vol II, 5th Ed, Elsevier, 2003
4.	B.K. Dutta "Mass Transfer", TMH, 2006.
5.	Principles and Fundamentals of Mass Transfer Operations - I (VOLUME I) by Dr. Kiran D Patil.
6.	Unit Operations – II [Heat and Mass Transfer] by K.A. Gavhane.

Year	II	CHL 3416 L: Mass Transfer Operation-I (Practical including Viva)	Hours per week	3
			Credits	1.5
Semester	II	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	Estimate the diffusivity of given samples in air at ambient condition.	CHL 3411L	2, 3	CO1, CO3, CO5	PSO1, PSO2
2	Evaluation of mass transfer coefficient for evaporation from the free surface of liquid to atmosphere.				
3	Obtain rate of mass transfer in stirred cell without mass transfer.				
4	Obtain rate of mass transfer in stirred cell with mass transfer.				
5	Determine diffusivity of Acetone – air at ambient condition using Wilke Lee equation.				
6	Study of internals of cooling tower.				
7	Determination of HETP for given sample.				
8	Study on column internals.				
9	Study of properties of air-water system by using psychrometric chart.				
10	To determine diffusivity of acetic acid in water.				



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Diploma in Petrochemical Technology: Full Time (Regular)

Year	III	CHL 3413: Process Calculation	Max. Marks	IA	20
				UA	80
Semester	II	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures and Tutorial (4L + 2T)

Prerequisite : Applied Mathematics, Basics of Unit Operations

Course Outcome (CO): CHL 3413

- CO1** Explain the importance of physical quantities of Units and Convert units among different systems.
- CO2** Apply the basic principles and importance of stoichiometry in process industries.
- CO3** Practice the concepts of material balance with and without chemical reaction.
- CO4** Compute the energy balance for different endothermic and exothermic reactions.
- CO5** Calculate the calorific values and the combustion efficiency of fuels.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Lev el	CO	PSO	Elem ents of Empl oyabi lity (Emp .) / Entre prene urshi p (Ent.) / Skill Devel opme nt (SD)	Rele vanc e to Local (L) / Natio nal (N) / Regio nal (R) / Globa l (G)	Rela tion to Gende r (G) / Envir onme nt and Sustai nabilit y (ES) / Huma n Value s (HV) / Profes sional Ethics (PE)
1.	Dimensions & Units Importance of process calculation, Dimensions & systems of units (MKS, CGS, FPS, SI), Fundamental and derived quantities, unit conversion examples	4	7	1	CO1	PSO1	Emp., SD	G	PE
2.	Basic chemical calculations Basic calculations of Atomic Weight, Molecular weight, Equivalent weight, Specific gravity, API gravity, composition of Solid & liquid, weight %, mole %, properties of solution, Raoult's law, Henry's law, Normality Molarity molality, gms/lit, PPM, TOC, THOD, BOD, COD. Concept of ideal gas law, STP, NTP, Ideal gas law for mixtures Dalton's law, Amagat's law, relationship Between Mole %, Vol.%, pressure %, calculation of average molecular weight, density, mole %, Weight %, in SI/MKS system only, equation of State	10	18	1,2	CO2	PSO1	Emp., SD	G	PE

3.	Psychrometry Definition of DB and WB temp., Dew point Absolute humidity, relative Humidity, Humid heat, humid volume, vapour Pressure, partial pressure, use of psychrometric chart.	5	9	1,2	CO2	PSO1	Emp., SD	G	PE
4.	Material balance without chemical reactions Fundamentals of material balance, Problems based on material balance without Chemical reactions in various unit operations (non-reactive processes)	4	7	1,2,3	CO3	PSO1, PSO2	Emp., SD	G	PE
5.	Material balances involving chemical reactions Definition of limiting reactant, excess reactant, Yield, conversion, problems based on material balance involving Chemical reactions.	10	18	1,2,3	CO3	PSO1	Emp., SD	G	PE
6.	Material balances involving chemical reactions Introduction Definition of limiting reactant, excess reactant, Yield, conversion, calculation involving Chemical reactions i.e. yield conversion, Composition simple calculation of material balance based on chemical reaction, Electro Chemical reaction	8	14	1,2,3	CO3	PSO1 PSO2	Emp., SD	G	PE
7.	Energy balances Mean Heat capacity of gases, calculation of Enthalpy of gases & gaseous mixture using heat Capacity data. Sensible heat changes in solids & liquids. Calculation of enthalpy of liquids & liquid mixture using heat capacity of liquids. Enthalpy changes accompanying chemical reactions, standard heat of formation standard heat of reaction, standard heat of combustion, Hess law of constant heat summation.	10	18	2,3,4	CO4	PSO1, PSO2	Emp., SD	G	PE

8.	Combustion Types of fuels, calorific values of fuels, brief idea about ultimate analysis & proximate analysis of solid fuel (coal), simple problems to find calorific value, calculation of air requirement in combustion	5	9	1,2,3,4	CO5	PSO1	Emp., SD	G	PE
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REFERENCES	
1.	B. I. Bhatt and S. M. Vora, "Stoichiometry", 4th Ed, Tata McGraw-Hill, 1976
2.	D.C. Sikdar, "Chemical Process Calculations", PHI publications, 2013
3.	K. V. Narayanan and B. Lakshmikutty, "Stoichiometry and Process Calculations" 2 nd Ed., PHI Publications, 2016
4.	Introduction to Stoichiometry – By K.A. Gavhane Nirali Prakashan

	The Maharaja Sayajirao University of Baroda Polytechnic Department of Petrochemical Technology Polytechnic, Near Shastri Bridge, Fatehgunj, Vadodara-2 www.msubaroda.ac.in	ACADEMIC YEAR (2022-2023)
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Diploma in Petrochemical Technology: Full Time (Regular)					
Year	II	CHL 3414: Petroleum Refining Engineering	Max. Marks	IA	20
				UA	80
Semester	II	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures and Laboratory (4L + 2P)
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Prerequisite : Applied Chemistry, Chemical Process industries, Fluid flow operation, Mechanical operation

Course Outcome (CO): CHL 3414

- CO1** Grasp the fundamentals of crude oil exploration, drilling, refining and transportation.
- CO2** Testing of petroleum products with their specifications and significance.
- CO3** Explain refining processes for light, middle and heavy distillates.
- CO4** Identify treatment processes to conform environmental standards of petroleum products.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Lev el	CO	PSO	Eleme nts of Employ ability (Emp.) / Entrepr eneursh ip (Ent.) / Skill Develop ment (SD)	Releva nce to Local (L) / Nationa l (N) / Regiona l (R) / Global (G)	Relati on to Gender (G) / Environ ment and Sustaina bility (ES) / Human Values (HV) / Professi onal Ethics (PE)
1.	Origin formation & composition of petroleum: History, origin and formation of petroleum, world reserves of petroleum, Development of petroleum refining in India, Indian refining scenario, Refinery block diagram	5	9	1,2	CO1	PSO1	Emp., SD	G	PE
2.	Exploration and Drilling: Reservoir characterization, Exploration & methods of exploration, Drilling, drilling equipment's, Recovery, Enhanced oil recovery, transportation of petroleum products.	6	11	1,2	CO1	PSO1, PSO2	Emp., SD	G	PE

3.	Petroleum processing data: Composition & classification of petroleum, Evaluation of petroleum, properties of petroleum fractions, Distillation characteristics, properties & test methods of petroleum products with their significance,	8	14	1,2,4	CO2, CO4	PSO1	Emp., SD	G	PE
4.	Fractionation of petroleum: Primary processing of crude oil (Dehydration, Desalting), heating of crude – pipe Still heaters, distillation of crude oil (ADU, VDU)	5	9	1,2	CO1, CO3	PSO1, PSO2	Emp., SD	G	PE
5.	Cracking: Definition of cracking, Feedstocks, chemistry and technology of Fluidized Catalytic Cracking, Hydrocracking	7	12	1,2	CO3	PSO1, PSO2	Emp., SD	G	PE
6.	Reforming: Purpose, Principles, feedstock of reforming, Catalytic reforming, Platforming	5	9	1,2	CO3, CO4	PSO1, PSO2	Emp., SD	G	PE
7.	Other Refinery processes: Vis breaking, Coking, Alkylation, Isomerisation, polymerisation. Asphalt: Upgradation of Heavy crude	7	12	1,2	CO3, CO4	PSO1, PSO2	Emp., SD	G	PE
8.	Lubricating Oil: Production of petroleum waxes, greases, asphalt Bitumen & carbon black	5	9	1,2	CO3, CO4	PSO2	Emp., SD	G	PE
9.	Treatment techniques of petroleum products, Desulfurization, Hydrodesulfurization	5	9	1,2	CO4	PSO2	Emp., SD	G	PE
10.	Future aspects: Clean Technologies, Future beyond Petroleum	3	6	1,2	CO1, CO4	PSO1, PSO2	Emp., SD	G	ES/PE

REFERENCES	
1.	B. K. Bhaskara Rao, “Modern Petroleum Refining Processes”, Oxford & IBH Publishing, 1984
2.	G.N. Sarkar, “Advanced Petroleum Refining”, Khanna Publishers, ed. 2nd, 2016
3.	W. Nelson, “Petroleum Refinery Engineering”, McGraw-Hill Education, 1958

Year	III	CHL 3414 L: Petroleum Refining Engineering	Hours per week	2
			Credits	1
Semester	II	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	To determine corrosivity of fuel due to sulphur. (In the form of sulphide, H ₂ S and acids.)	CHL 3414 L	2, 3	CO ₂ , CO ₃ , CO ₄	PSO ₁ , PSO ₂
2	To find the penetration number of give bituminous material by penetrometer.				
3	To determine the density of the given petroleum product by hydrometer.				
4	To find out the aniline point and diesel index of given petroleum product.				
5	To find out IBP, FBP and dry point of given petroleum product by ASTM distillation.				
6	To determine the smoke point of given petroleum product by Smoke point apparatus.				
7	To find out cloud point and pour point of given petroleum product by Cloud & Pour point apparatus.				
8	To find out % carbon residue on give petroleum product by CONRADSON CARBON RESIDUE.				

9	To determine Flash point of given petroleum sample by Cleveland open cup apparatus.				
10	To determine softening point of given bituminous material by softening point apparatus.				
11	To determine calorific value of given fuel by Junker's gas calorimeter.				
12	To determine the viscosity of given petroleum product by Saybolt viscometer.				
13	To Generate EFV curve at different pressure from ASTM distillation data.				
14	To find out vapour pressure of given petroleum fuel and its volatility by Reid vapor pressure apparatus.				
15	To determine flash and fire point of petroleum product by Pensky – Martein's Closed cup apparatus.				

Syllabus of FIRST SEMESTER TYD PCT

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: Diploma in Petrochemical Technology

Programme Specific Outcome (PSO)

- PSO1** : To apply the understanding and knowledge of basic sciences, engineering, laboratory skills, tools, and methodologies to provide appropriate solutions in the field of chemical and process industries.
- PSO2** : To develop professional approach in managing production, operations, maintenance, and design of safe and sustainable chemical processes.



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**ACADEMIC
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Diploma in Petrochemical Technology: Full Time (Regular)

Year	III	CHL 3519 L: Chemical Engineering Computation	Max. Marks	IA	50
				UA	-
Semester	I	Core / Elective / Foundation	Total Hours		28
			Hours per week		2
			Credits		2

Mode of Transaction : Laboratory/ TW Viva (2P)

Prerequisite : Basic computer application, process calculation, unit operation

Course Outcome (CO): CHL 3519 L

- CO1** Utilize simulation software tools to model and analyse chemical engineering processes.
- CO2** Prepare and organize data in MS Excel for simulation purposes.
- CO3** Apply different tools of MS Excel to solve chemical engineering problems.
- CO4** Evaluate and compare simulation results with actual calculations.
- CO5** Demonstrate and discuss the applications of different simulation software in solving practical chemical engineering challenges.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Leve l	CO	PSO	Eleme nts of Employ ability (Emp.) / Entrepre neurship (Ent.) / Skill Develop ment (SD)	Releva nce to Local (L) / National (N) / Regiona l (R) / Global (G)	Relatio n to Gender (G) / Environ ment and Sustainab ility (ES) / Human Values (HV) / Professio nal Ethics (PE)
1.	Problem Solving with Excel: Application of Logical Functions, Pivot Tables - Charts, Solver and other Excel features to solve chemical engineering problems.	10	36	1, 2, 3, 4, 5	CO2, CO3	PSO1, PSO2	Emp., SD	G	PE
2.	Introduction to some open-source software for steady and dynamic simulation of chemical engineering systems with property estimation, Material & Energy balance, and general design.	10	36	1, 2	CO1	PSO1, PSO2	Emp., SD	G	PE
3.	Students will be assigned computational / simulation exercises to be worked out using open-source simulators.	8	28	1, 2, 3, 4, 5	CO4, CO5	PSO1, PSO2	Emp., SD	G	PE

Year	III	CHL 3519 L: Chemical Engineering Computation (Practical including Viva)	Hours per week	2
			Credits	1
Semester	I	Core / Elective / Foundation	Maximum Marks	50

N o.	Practical	BT Level	CO	PSO
1.	Data visualization with pivot table, graphs and trendlines	1, 2, 3, 4, 5	CO1, CO2 CO3, CO4, CO5	PSO1, PSO2
2.	Function development using VBA			
3.	Regression with solver and goal seek			
4.	Design_1 (Mixer)			
5.	Design_2 (Azeotrope calculation)			
6.	Design_3 (Heat Exchanger design)			
7.	Introduction to other software (HTRI, DWSIM, POLYMATH)			



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Diploma in Petrochemical Technology: Full Time (Regular)

Year	III	CHL 3517: Chemical Engineering Thermodynamics	Max. Marks	IA	20
				UA	80
Semester	I	Core / Elective / Foundation	Total Hours		56
			Hours per week		4
			Credits		4+2

Mode of Transaction : Lectures and Tutorial (4L+2T)

Prerequisite : Applied Sciences, Applied Mathematics

Course Outcome (CO): CHL 3517

- CO1** Apply the laws of thermodynamics in real-world scenarios.
- CO2** Compute thermodynamic properties of components and mixtures, including non-ideal systems.
- CO3** Analyse the behaviour of non - ideality prevailing in Gas/vapor and liquid phase mixtures.
- CO4** Discuss thermodynamic properties for homogeneous phase and its application.
- CO5** Predict the impact of pressure, temperature, and composition changes on phase equilibria.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp.) / Entrepreneurship (Ent.) / Skill Development (SD)	Relevance to Local (L) / National (N) / Regional (R) / Global (G)	Relation to Gender (G) / Environment and Sustainability (ES) / Human Values (HV) / Professional Ethics (PE)
1.	Scope of Thermodynamics First law of Thermodynamics systems & surroundings Thermodynamic property, state function Internal Energy, Enthalpy, work done, Equilibrium, phase Rule, Types of process, constant volume and Constant pressure process, Heat capacity	7	12	1, 2	CO1, CO2	PSO1	Emp., SD	G	PE
2.	Second law of Thermodynamics Statements of the second law of Thermodynamics, Mathematical statement of second law, Heat Engine, Thermodynamic temperature scale, Carnot cycle, Concept of Entropy and Entropy change based on ideal gas, Entropy balance, Ideal and lost work.	5	9	1, 2, 3	CO1, CO2	PSO1	Emp., SD	G	PE
3.	Application of the first and second laws of thermodynamics to flow processes. Pipe flow, nozzles, throttling, turbine, compressor, pump, ejectors	4	7	2, 3	CO1, CO2	PSO1	Emp., SD	G	PE

4.	Refrigeration & liquefaction: Carnot refrigeration, The vapour recompression cycle, Compression of refrigeration cycle, Types of refrigerants & their codes, selection of Refrigerants, Heat Pump, and Liquefaction processes. concepts of COP & circulation rate, concept of liquefaction and cycles.	4	7	1, 2, 3	CO1, CO2	PSO1	Emp., SD	G	PE
5.	Phase diagrams and concept of non-ideality: Phase diagrams for pure species, Concept of non-ideality, Various models for determination of non-ideality – Pitzer, Virial EOS, vW CEOS	10	18	1, 2, 3	CO2, CO3	PSO1, PSO2	Emp., SD	G	PE
6.	Non-ideality prevailing in gases and liquids: Concept of Gibbs energy, Fundamental property relations, Maxwell's equation, Residual properties, Concept of fugacity and its computation using various models, Partial molar properties, Gibbs-Duhem equation, Excess properties, Concept of activity coefficient, Excess Gibbs energy models - Margule's 2 suffix, Margule's 3 suffix, Van Laar.	10	18	1, 2, 3, 4	CO2, CO3	PSO1, PSO2	Emp., SD	G	PE
7.	Vapour-Liquid equilibria Criterion for pure species: Vapour pressure, Clausius-Clapeyron, Antoine equation, Introduction to VLE – Raoult's law, Modified Raoult's law, BUBLP, BUBLT, DEWP, DEWT, Flash calculations, Phase diagrams for binary systems, Concept of azeotropy.	10	18	1, 2, 3, 4	CO4, CO5	PSO1, PSO2	Emp., SD	G	PE
8.	Chemical Equilibrium Criteria of chemical equilibrium, Effect of P and T on equilibrium conversion (Xe) and equilibrium constant (K), methods of evaluation of K & Xe, Xe charts for Exothermic, Endothermic, Reversible and irreversible reactions etc.	6	11	1, 2	CO5	PSO1, PSO2	Emp., SD	G	PE

REFERENCES	
1.	J. M. Smith, H. C. Van Ness, M. M. Abbott, "Introduction to chemical engineering thermodynamics", McGraw-Hill, 2001
2.	PK Nag, "Engineering Thermodynamics", 6 th Ed, McGraw-Hill, 2017
3.	R.K. Rajput, "A Textbook of Engineering Thermodynamics", 3 rd Ed, Laxmi Publications, 2007



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**ACADEMIC
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Diploma in Petrochemical Technology: Full Time (Regular)

Year	III	CHL 3515: Heat Transfer Operation	Max. Marks	IA	20
				UA	80
Semester	I	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures and Laboratory (4L + 3P)

Prerequisite : Applied science, Applied Mathematics, Fluid flow operation, Chemical Process Industries

Course Outcome (CO): CHL 3515

- CO1** Discuss the modes of heat transfer in fluids and solids and their applications in heat transfer equipment.
- CO2** Analyse and solve problems related to various modes of heat transfer.
- CO3** Design and analyse the performance of heat exchangers and evaporators.
- CO4** Use of heating, cooling, and insulation systems.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp.) / Entrepreneurship (Ent.) / Skill Development (SD)	Relevance to Local (L) / National (N) / Regional (R) / Global (G)	Relation to Gender (G) / Environment and Sustainability (ES) / Human Values (HV) / Professional Ethics (PE)
1.	Modes of Heat transfer Modes of heat transfer- Introduction, Importance of heat transfer in process industries, Steady state and unsteady state heat transfer	4	7	1,2	CO1	PSO1	Emp., SD	G	PE
2.	Heat transfer by conduction Flux, Temp. gradient, Fourier's law Thermal conductivity & its valuation with temperature, Steady state (S.S.) heat conduction through composite wall of uniform shapes (up to three layers)	7	12	1,2,3	CO1, CO2	PSO1	Emp., SD	G	PE
3.	Heat transfer by convection Types of convection, Newton's law of convection, individual and overall Heat Transfer Coefficient, Concept of Prandtl number, Nusselt number, Grashoff numbers, Laminar & Turbulent flow in pipes & tubes – Sieder & Tate Equation, Dittus Bolter equation	6	11	1,2,3	CO1, CO2	PSO1	Emp., SD	G	PE

4.	Heat transfer for condensing vapours (Phase change) a) Boiling – Types of boiling, boiling regimes, factors influencing the rate of heat transfer in boiling. b) Condensation- Film type condensation. Dropwise condensation, Correlation with heat transfer coefficient.	7	12	1,2	CO1, CO4	PSO1	Emp., SD	G	PE
5.	Heat transfer by radiation Stefan-Boltzmann's law, Types of body, emissive power of Black body, emissivity, Planck's law, Kirchoff's Law, radiation shield, shape factor, calculation of heat loss in atmosphere.	5	9	1,2,3	CO1, CO2	PSO1	Emp., SD	G	PE
6.	Heat exchangers Heat exchangers classification and selection, TEMA table, concept of co-current & counter current flow, temperature range and Log mean temp. Difference, sketches of shell and tube heat exchangers, heat exchanger calculations.	14	25	2,3,5	CO3	PSO1, PSO2	Emp., SD	G	PE
7.	Evaporation Classification and selection of evaporators, capacity, and economy, single effect evaporator and multi-effect Evaporator, feed arrangement in multiple-effect evaporator.	7	12	1,2,3	CO3, CO4	PSO2	Emp., SD	G	PE
8.	Tubular furnaces Application, classification & types of tubular furnaces	4	7	2,3	CO4	PSO2	Emp., SD	G	PE
9.	Media and methods of heating & cooling: water, steam, oil, molten salt, dowtherm, Electric heating, Furnace heating etc.	2	5	1,3	CO4	PSO1, PSO2	Emp., SD	G	PE

REFERENCES

1.	D.Q. Kern, "Process Heat Transfer", 5th Ed, McGraw-Hill, 1965
2.	J.M. Coulson & J.F. Richardson "Chemical Engineering", Vol. I, 6th Ed, Elsevier, 2004

3.	W.L. McCabe, J.C. Smith, P. Harriot, “Unit Operations of Chemical Engineering”, 7th Ed, McGraw Hill, 2006.
4.	Y.V.C. Rao, “Heat transfer”, 2nd Ed, 2001
5.	Unit Operations – II [Heat and Mass Transfer] by K.A. Gavhane. Unit Operations – II [Heat and Mass Transfer] by K.A. Gavhane.

Year	III	CHL 3515 L: Heat Transfer Operation (Practical including Viva)	Hours per week	3
			Credits	1.5
Semester	I	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	Performance of Shell and Tube Heat Exchanger.	CHL 3515L	2, 3	CO1, CO2, CO3, CO4	PSO1, PSO2
2	Determination of overall heat transfer coefficient in double pipe heat exchanger.				
3	Performance of split flow condenser.				
4	Study of drop wise and film wise condensation.				
5	Determination of overall heat transfer coefficient in shell and tube Heat exchanger				
6	Study of plate type heat exchanger				
7	Study of multiple effect evaporator.				
8	Study of principle action of thermodynamic steam trap.				
9	Determination of overall heat transfer coefficient for agitated vessel.				
10	Determination of overall heat transfer coefficient for open pan evaporator.				

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Diploma in Petrochemical Technology: Full Time (Regular)

Year	III	CHL 3518: Mass Transfer Operation- II	Max. Marks	IA	20
				UA	80
Semester	I	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures and Laboratory (4L+3P)

Prerequisite : Applied Science, Mass Transfer Operation- I, Fluid flow operation, Chemical Process Industries

Course Outcome (CO): CHL 3518

- CO1** Identify and classify various mass transfer equipment used in industrial processes.
- CO2** Interpret the use of separation processes in the chemical process industries / refineries.
- CO3** Identify the steps in designing mass transfer equipments used in the chemical industries.
- CO4** Recognize the practical importance and relevance of mass transfer in chemical industry
- CO5** Discuss and evaluate the impact of operating conditions on the efficiency of mass transfer operations.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp.) / Entrepreneurship (Ent.) / Skill Development (SD)	Relevance to Local (L) / National (N) / Regional (R) / Global (G)	Relation to Gender (G) / Environment and Sustainability (ES) / Human Values (HV) / Professional Ethics (PE)
1.	<u>Distillation</u> Vapour liquid equilibria, phase diagram, Relative volatility, Distillation techniques with constructional and operational features of differential, flash, steam, fractional, azeotropic and extractive distillation etc., Binary system, material balance and energy balance for fractionating column, condenser and reboiler heat duty, Types of reflux ratio, calculation of ideal stages by McCabe Thiele method, Introduction of feed, location of feed tray. Types of tray efficiencies	15	27	1,2,3,4	CO1, CO2, CO3, CO4	PSO1 PSO2	Emp., SD	G	PE
2.	<u>Crystallization</u> Types of crystals and crystal geometry, crystal formation, phase diagram, Mier's supersaturation theory and its limitation, material and Energy balance calculation, crystal yields, effect of operating condition on caking of crystals, prevention of caking, Constructional and operational features of types of crystallizers.	6	11	1,2,3	CO2, CO3, CO5	PSO1 PSO2	Emp., SD	G	PE

3.	<u>Membrane separation processes</u> Types of Membrane – Brief introduction of membrane Separation processes like Reverse osmosis, Micro filtration, Ultra filtration, Dialysis, pervaporation, permeation	4	7	2,3	CO ₂ , CO ₄	PSO1	Emp., SD	G	PE
4.	<u>Liquid – Liquid Extraction</u> Field of usefulness, properties and requirement of solvent, equilateral triangular diagram, Types of various systems and their effect on equilateral triangular diagram, Stage wise & continuous contacting equipment's with their classification.	9	16	2,3	CO ₂ , CO ₃ , CO ₅	PSO1	Emp., SD	G	PE
5.	<u>Drying</u> Definition of various terms, application of drying, Drying curve, rate of drying, time of drying, Operational Classification and working of drying equipment's, selection of drying equipment.	10	18	1,2,3	CO ₂ , CO ₃ , CO ₄ , CO ₅	PSO1 PSO2	Emp., SD	G	PE
6.	<u>Adsorption and Ion exchange</u> Definition- Industrial application, types of adsorptions, Adsorption equilibria, Properties, and application of adsorbents, Freundlich equation and its scope, Adsorption operation of various equipment's, Ion Exchange-principles and its use in D.M. water.	5	9	2,3	CO ₂	PSO1	Emp., SD	G	PE
7.	<u>Leaching</u> Principle and application of leaching, Types of leaching, Methods, and operation of leaching equipment's (Percolation tank, Shank system, Agitated vessels, Bollman extractor etc.)	7	12	2,3	CO ₁ , CO ₅	PSO1 PSO2	Emp., SD	G	PE

REFERENCES

1.	R.E. Treybal, "Mass – Transfer Operation" 3rd Ed, Mc Graw Hill, 1981
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2.	W.L. Mc Cabe, J.C. Smith, P. Harriot, “Unit Operations of Chemical Engineering” 7th Ed, McGraw Hill, 2006.
3.	J.M. Coulson & J.F. Richardson, “Chemical Engineering” Vol I, 6th Ed, Elsevier, 2004
4.	K.A. Gavhane, “Unit Operations – II [Heat and Mass Transfer]”
5.	B.K. Dutta, “Principles of Mass Transfer and Separation Process”, TMH, 2006.
6.	Dr. Kiran D Patil, “Principles and Fundamentals of Mass Transfer Operations – I”, Volume-I

Year	III	CHL 3518 L: Mass Transfer Operation- II	Hours per week	3
			Credits	1.5
Semester	I	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	To determine the solubility with change in temperature of given substance (Nacl) in water.	CHL 3518L	2, 3	CO1,	PSO1, PSO2

2	To determine the solubility with change in temperature of given substance (MnSO_4) in water			CO ₂ , CO ₃ , CO ₄	
3	To study the adsorption of acetic acid/oxalic acid on charcoal and verify the Freundlich adsorption isotherm.				
4	To determine the rate of drying characteristics curve for a given sample in the infrared moisture balance under atmospheric pressure.				
5	To study the crystallization of alum and the effect of seeding.				
6	To verify Rayleigh's equation for simple distillation				
7	To study the effect of quality of solvent used for leaching on % recovery basis.				
8	To determine % recovery of acetic acid by separation of binary mixture of acetic acid and benzene (using water as solvent) by three stage extraction and hence stage efficiency.				
9	To verify the law for steam distillation.				
10	To determine the composition of vapor and liquid in equilibrium at a particular temperature and at constant pressure and hence to plot VLE distribution curve.				

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Diploma: Full Time (Regular)		

Year	III	CHL 3520: Petrochemicals Technology	Max. Marks	IA	20
				UA	80
Semester	I	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction	: Lectures (4L)
Prerequisite	: Applied chemistry, Petroleum refining engineering, Unit operation, Chemical Process Industries
Course Outcome (CO): CHL 3520	
CO1	Classify different purification and separations processes for feedstocks related to oil and gas industry.
CO2	Discuss different Petrochemicals obtained from various feedstocks with their production processes.
CO3	Identify and compare the usage of C1 – C4 compounds from the various routes and it's the value addition in petrochemical processes.
CO4	Discuss engineering problems and operational challenges in petrochemical industries.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Leve l	CO	PSO	Elem ents of Empl oyabil ity (Emp.) / Entre prene urship (Ent.) / Skill Devel opme nt (SD)	Rele vanc e to Local (L) / Natio nal (N) / Regio nal (R) / Globa l (G)	Relat ion to Gende r (G) / Enviro nment and Sustai nabilit y (ES) / Huma n Values (HV) / Profes sional Ethics (PE)
1.	Petrochemicals Definition, History, Major petrochemical products & their Producers in India raw materials for petrochemicals, Naphtha cracking, Natural gas Production and Processing.	10	18	1,2,3	CO1, CO2	PSO1, PSO2	Emp., SD	G	PE

2.	C 1 compounds Methanol & formaldehyde	4	7	1,2,3	CO ₂ , CO ₃ , CO ₄	PSO ₁ , PSO ₂	Emp., SD	G	PE
3.	C 2 compounds Acetylene, Ethylene, vinyl chloride, Ethanol, Acetic acid	9	16	1,2,3	CO ₂ , CO ₃ , CO ₄	PSO ₁ , PSO ₂	Emp., SD	G	PE
4.	C 3 compounds Propylene, Acetone & cumene, Acrylonitrile, Acrylic acid, M.M.A.	10	18	1,2,3	CO ₂ , CO ₃ , CO ₄	PSO ₁ , PSO ₂	Emp., SD	G	PE
5.	C 4 compounds Butadiene, Isobutylene, Butanol , Isoprene	6	11	1,2,3	CO ₂ , CO ₃ , CO ₄	PSO ₁ , PSO ₂	Emp., SD	G	PE
6.	Aromatics BTX separation and production, Phenol, Benzaldehyde, Terephthalic acid, DMT, Phthalic Anhydride, Maleic anhydride.	12	21	1,2,3	CO ₂ , CO ₄	PSO ₁ , PSO ₂	Emp., SD	G	PE
7.	Synthetic Detergents : Feedstocks , processes (Parex , Molex , IsoSiv etc)	5	9	1,2,3	CO ₂ , CO ₄	PSO ₁ , PSO ₂	Emp., SD	G	PE

REFERENCES

1.	I.D. Mall , “Petrochemical process technology”, Laxmi publications, 2017
2.	B. K. Bhaskara Rao, “A Text on Petro Chemicals”, Khanna Publishers, 2004
3.	G.N. Sarkar, “Advanced Petrochemicals”, Khanna Publishers, 1998
4.	Dryden’s Outlines Of Chemical Technology By M. Gopala Rao Marshall Sittig
5.	Encyclopaedia of Hydrocarbon for Refining and Petrochemicals by Mario Beccari, Ugo Romano ENI,2006



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Diploma: Full Time (Regular)

Year	III	CHL 3516: Plant Operation	Max. Marks	IA	20
				UA	80
Semester	I	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures (L4)

Prerequisite : Unit Processes and Unit Operations

Course Outcome (CO): CHL 3516

- CO1** Identify start-up, shutdown, and commissioning activities of the major unit operations in chemical process industries.
- CO2** Perform troubleshooting activities during various plant emergency conditions.
- CO3** Discuss different aspects of EPC companies.
- CO4** Apply knowledge of standard operating and maintenance procedures of various equipment.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Leve l	CO	PSO	Elem ents of Empl oyabil ity (Emp.) / Entre prene urship (Ent.) / Skill Devel opme nt (SD)	Rele vanc e to Local (L) / Natio nal (N) / Regio nal (R) / Globa l (G)	Relat ion to Gende r (G) / Enviro nment and Sustai nabilit y (ES) / Huma n Values (HV) / Profes sional Ethics (PE)
1.	Basic steps of plant operation in industries, Concept of maintenance, commissioning and break down failures, Introduction to EPC Company	6	11	1, 2	CO1, CO3	PSO1, PSO2	Emp., SD	G	PE
2.	Types of maintenance, preventive maintenance, Types of preventive maintenance, Record of maintenance & their relative usefulness, Modern Management & maintenance techniques.	8	14	1, 2, 3	CO5	PSO1, PSO2	Emp., SD	G	PE
3.	Operation aspect of Fluid moving machineries.	8	14	1, 2, 3	CO1, CO2, CO4	PSO1, PSO2	Emp., SD	G	PE
4.	Operational aspects of Heat transfer equipment.	8	14	1, 2, 3	CO1, CO2, CO4	PSO1, PSO2	Emp., SD	G	PE
5.	Operational aspects of Separating columns.	6	11	1, 2, 3	CO1, CO2, CO4	PSO1, PSO2	Emp., SD	G	PE
6.	Operational aspects for the equipment such as dryers, crystallisers & cooling tower.	6	11	1, 2, 3	CO1, CO2, CO4	PSO1, PSO2	Emp., SD	G	PE

7.	Operational aspects for various reactors.	6	11	1, 2, 3	CO1, CO2, CO4	PSO1, PSO2	Emp., SD	G	PE
8.	Operational aspects for different Utilities.	8	14	1, 2, 3	CO1, CO2, CO4	PSO1, PSO2	Emp., SD	G	PE

REFERENCES

1.	T. M. Cook and D. J. Cullen, “Chemical Plant and Its Operation: Including Safety and Health Aspects”, 2 nd SI Ed, Pergamon Press, 1985
2.	Keith Mobley, Lindley Higgins, Darrin Wikoff, “Maintenance Engineering Handbook”, McGraw-Hill, 2008
3.	Safe and Efficient Plant Operation and Maintenance Edited by Richard Green staff of chemical Engg. Mc. Graw Hill, New York.
4.	Martin Killcross, “Chemical and Process Plant Commissioning Handbook: A Practical Guide to Plant System and Equipment Installation and Commissioning”, 1 st Ed, Butterworth-Heinemann, 2011

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Diploma in Petrochemical Technology: Full Time (Regular)		

Year	III	CHL 3514 L: Project Work - I	Hours per week	3
Semester	I		Credits	1.5
		Core / Elective / Foundation	Maximum Marks	50

Prerequisite : Basic computer practice, Basic knowledge of chemical engineering	
Course Outcome (CO): CHL 3514 L CO1 Identify the resources for Specific topic CO2 Able to understand the type / quality of resources and select according to the need CO3 Comprehend the written report and prepare the power point presentation CO4 Able to solve the queries	

No.	Topic		Course Code	BT Level	CO	PSO
1	Some selected topics will be given in a group of 4-5 students. Students will do Literature survey and will be required to present that topic in seminar to be held during the college hours. The topics will be interchanged, and all students will have the knowledge of all the topics of seminar work.		CHL 3514 L	1,2,3	1,2,3,4	1,2

Syllabus of SECOND SEMESTER TYD PCT

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: Diploma in Petrochemical Technology

Programme Specific Outcome (PSO)

PSO1 : To apply the understanding and knowledge of basic sciences, engineering, laboratory skills, tools, and methodologies to provide appropriate solutions in the field of chemical and process industries.

PSO2 : To develop professional approach in managing production, operations, maintenance, and design of safe and sustainable chemical processes.



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Diploma in Petrochemical Technology: Full Time (Regular)

Year	III	CHL 3624: Chemical Reaction Engineering	Max. Marks	IA	20
			UA	80	
Semester	II	Core / Elective / Foundation	Hours per week		3
			Credits		3
Mode of Transaction : Lectures and Laboratory (3L + 2P)					
Prerequisite : Applied Science, Applied Mathematics, Unit Process, Chemical Engineering Thermodynamics					
Course Outcome (CO): CHL 3624					
CO1 Analyse reaction kinetics and the factors influencing reaction rates.					
CO2 Compare different reactor types and their suitability for various chemical processes.					
CO3 Design and compare different reactors for specific chemical processes.					
CO4 Evaluate the effects of catalysts on reaction rates.					
CO5 Analyse the fundamental principles governing reaction kinetics in both catalytic and non-catalytic heterogeneous systems.					

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp.) / Entrepreneurship (Ent.) / Skill Development (SD)	Relevance to Local (L) / National (N) / Regional (R) / Global (G)	Relation to Gender (G) / Environment and Sustainability (ES) / Human Values (HV) / Professional Ethics (PE)
1.	Overview of Chemical Reaction Engineering Classification of chemical reactions, Definition of Reaction Rate, Variables Affecting the Rate of Reaction, Speed of Chemical Reactions.	5	12	1, 2	CO1	PSO1	Emp., SD	G	PE
2.	Homogeneous Reactions Concentration Dependent Terms of a Rate Equation, Rate constant, Order of reaction, Molecularity of reaction, difference between Molecularity & order of reaction, elementary & non-elementary reactions. Temperature - Dependent Terms of a Rate Equation, Thermodynamics Theory, Collision Theory, Transition State Theory.	10	24	1, 2, 3	CO1	PSO1	Emp., SD	G	PE
3.	Collection and Analysis of Rate Data The Algorithm for Data analysis, Batch reactor data, Methods of initial rate and half-life, Differential reactors, Experimental Planning and Evaluation of Laboratory Reactor.	8	19	1, 2, 3, 4	CO1	PSO1, PSO2	Emp., SD	G	PE
4.	Ideal Reactors Introduction to reactor design, concept of ideal reactors, development of design expression for batch, tubular and stirred tank reactor.	8	19	1, 2, 3, 4	CO2, CO3	PSO1, PSO2	Emp., SD	G	PE

5.	Non-catalytic Heterogeneous Reactions: Fundamentals, influence of mass transfer, Reaction regimes and their identification, Selection of contactors for G-L and L-L reactions.	5	12	1, 2, 4	CO1, CO4, CO5	PSO1	Emp., SD	G	PE
6.	Catalytic Heterogeneous Reactions Definitions, Catalyst Properties, Classification of Catalyst, Catalyst Deactivation Fundamentals of heterogeneous reacting systems, the influence of mass transfer on reaction rates, Steps involving Catalytic Reaction, Overview on synthesizing rate law, Mechanism and Rate limiting step, Fluidized bed reactor.	6	14	1, 2	CO1, CO5	PSO1	Emp., SD	G	PE

REFERENCES

1.	O. Levenspiel, Chemical Reaction Engineering, 3rd Edn, Wiley & Sons, 1999
2.	H. S. Fogler, Elements of Chemical Reaction Engineering, 3rd Ed., Prentice-Hall, Englewood Cliffs, 1999
3.	J. J. Carberry, Chemical and Catalytic Reaction Engineering, McGraw-Hill, New York, 1976
4.	J. M. Smith, Chemical Engineering Kinetics, 3rd Ed., McGraw-Hill, New York, 1981

Year	III	CHL 3624 L: Chemical Reaction Engineering	Hours per week	3
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			Credits	1.5
Semester	II	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	First order Reaction	CHL 3624L	2, 3	CO1, CO2, CO4	PSO1, PSO2
2	Effect of Temperature on Rate				
3	Second order reaction				
4	Stirred Cell				
5	Effect of Catalyst on rate loading				
6	Batch reactor kinetics				

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Diploma in Petrochemical Technology: Full Time (Regular)

Year	III	CHL 3620: Entrepreneurship Development and Management	Max. Marks	IA	20
				UA	80
Semester	II	Core / Elective / Foundation	Hours per week		4
			Credits		4
Mode of Transaction : Lectures (4L)					
Prerequisite : Plant Operation, Chemical Process Industries					
Course Outcome (CO): CHL 3620 CO1 Comprehend entrepreneurship development, fundamentals of management and the process necessary to become an entrepreneur. CO2 Identify resources in support of entrepreneurs at state and central level. CO3 Recognize labour laws with relation to employment, safety, and compensation. CO4 Explain the importance of discipline, motivation, budget, quality, and quality standards as per market requirement. CO5 Comprehend project management techniques and their applications.					

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PS O	Elements of Employability (Emp.) / Entrepreneurship (Ent.) / Skill Development (SD)	Relevance to Local (L) / National (N) / Regional (R) / Global (G)	Relation to Gender (G) / Environment and Sustainability (ES) / Human Values (HV) / Professional Ethics (PE)
1.	Introduction Define Entrepreneurship, Entrepreneurship and Enterprise, small scale and large-scale industries, Feasibility report, preliminary project report (PPR), Preparation of PPR, Importance of entrepreneurship, Sole proprietorship, state entrepreneurship, co-operative Enterprises. MSME and support for MSME	7	12	1, 2	CO1	PSO2	Emp., Ent., SD	G	PE, HV
2.	Resources for Entrepreneurs Procedure for government assistance, various government & semi government bodies, GIDC, SIDBI, State Finance Corporation, Government support for Startups.	4	7	1, 2	CO2	PSO2	Emp., Ent., SD	G	PE
3.	Motivation and Training Motivation of worker, Factory Acts & other government Laws for functioning, developing an entrepreneurial Personality.	6	11	1, 2	CO3	PSO2	Emp., Ent., SD	G	PE, HV
4.	Business opportunities Identification & selection of business opportunity, availability of processes and techniques, environmental aspects, plant location and layout, product profile, preparation & product selection.	10	18	1, 2	CO1 CO2	PSO2	Emp., Ent., SD	G	PE, HV, ES

5.	Market survey Tools & Techniques, field, and market Survey reports. Digital media surveys.	6	11	1, 2	CO1 CO2	PSO2	Emp., Ent., SD	G	PE
6.	Sector development Introduction, Indian Industry, fundamental concepts and Growth of Indian manufacturing industry, stages of Scientific & technology revolution in India, Major area of Indian Industry, Globalization of Indian Industry.	4	7	1, 2	CO1 CO2	PSO2	Emp., Ent., SD	G	PE
7.	Introduction to ISO 9000 series, ISO 14000 & TQM, store control, Inventory control, preventive maintenance.	5	9	1, 2	CO3 CO4	PSO2	Emp., Ent., SD	G	PE
8.	Concept of management Introduction to Management, scientific management, Materials and purchase management, cost Estimation and Value engineering. Concept of Budgetary control, PPC, routing, scheduling dispatching. Follow-up. Work study and Motion study	7	12	1, 2	CO1 CO4	PSO2	Emp., Ent., SD	G	PE, HV
9.	Supervisor activities Supervisor's role objectives, introduction to CPM and PERT, productivity concept & its applications, Industrial discipline steps to be taken by supervisor in Managing his job.	7	13	1, 2, 3, 4	CO4 CO5	PSO1 PSO2	Emp., Ent., SD	G	PE, HV

REFERENCES

1.	B.V. Pathak, "A Textbook of Industrial Organization and Supervisory Management", Nirali Prakashan, 2000
2.	L. Bethel, "Industrial organization & management", McGraw-Hill Inc., US, 1979
3.	O.P. Khanna, "Industrial Engineering and Management", Ganpatray Publication, 2018



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Diploma in Petrochemical Technology: Full Time (Regular)

Year	III		Max.	IA	20
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		CHL 3621: Health, Safety & Environment	Marks	UA	80
Semester	II	Core / Elective / Foundation	Hours per week		4
			Credits		4
Mode of Transaction : Lectures and Laboratory (4L + 2P)					
Prerequisite : Unit Operations and Unit Processes, Plant Operation					
Course Outcome (CO): CHL 3621					
CO1 Outline safety protocols and environmental considerations in the chemical industry.					
CO2 Classify the types of hazards in chemical plants and preventive measures.					
CO3 Discuss various Industrial Acts regarding safety in the chemical plant.					
CO4 Discuss the various components of the environment, different types of environmental pollution, and global environmental concerns with their preventive measures.					
CO5 Demonstrate a comprehensive understanding of the principles and characteristics of both renewable and non-renewable energy sources.					

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp.) / Entrepreneurship (Ent.) / Skill Development (SD)	Relevance to Local (L) / National (N) / Regional (R) / Global (G)	Relation to Gender (G) / Environment and Sustainability (ES) / Human Values (HV) / Professional Ethics (PE)
1.	Introduction to safety Definition of safety, Importance of safety in chemical industries, plant layout for safety, Safety Regulatory Bodies (National safety council, International Labor Organization).	4	7	1,2	CO1	PSO2	Emp., SD	G	PE, ES
2.	Hazards Introduction and types of hazards (chemical, Mechanical, Electrical, Radiation, Noise and vibrating)	8	14	1,2	CO2	PSO1	Emp., SD	G	PE, ES
3.	Fire and Explosion Hazards Theory of fire & explosions, flammability, types of fires and explosion, fire extinguishing agents, fire protection in industries, Fire alarms, and firefighting activities.	6	11	1,2	CO2	PSO1	Emp., SD	G	PE, ES
4.	Personal Protective equipment Protective equipment for head, ears, eyes, face, hand and feet, breathing apparatus.	3	6	2,3	CO2	PSO1	Emp., SD	G	PE, ES
5.	Safe handling of hazardous chemicals Hazardous Properties of chemicals (chlorine, Ammonia, caustic soda, Inorganic Acids, carbon monoxide, phosgene), transportation and storage of hazardous chemicals.	5	9	2,3	CO1, CO2	PSO1	Emp., SD	G	PE, ES

6.	Toxicology Introduction to Toxicity and Toxicant, Various types of toxic effects and their treatment, Factors affecting Toxic action, Dosage - response relationship.	4	7	2,3	CO1, CO2	PSO1	Emp., SD	G	PE, ES
7.	Hazard Identification and Risk Assessment Hazard Identification Methods, Hazard operability Studies & Risk management and Control measure.	6	11	2,3	CO1, CO2	PSO2	Emp., SD	G	PE, ES
8.	Industrial safety and related Acts Industrial Safety, Causes and types of accidents, safety procedures, Permit system. The factories acts, Industrial Disputes Act, Boiler Act, ESI Act.	4	7	1, 2, 3	CO3	PSO1, PSO2	Emp., Ent., SD	G	PE, ES
9.	Environmental Pollution Concept and components of environment, Water pollution, Air pollution, Land Pollution, Noise pollution, Thermal pollution.	8	14	1,2	CO4	PSO1, PSO2	Emp., SD	G	PE, ES, HV
10.	Global environmental Issues & Energy conservation Introduction, acid rain, greenhouse effect, and ozone layer depletion. Measures against global problems. Conventional & non-conventional energy sources.	8	14	1,2	CO4, CO5	PSO1, PSO2	Emp., SD	G	PE, ES, HV

REFERENCES

1.	C.S. Rao, “Environmental pollution control Engineering”, New Age International Publishers, ed. 3 rd , 2018
2.	Safety manuals for plant supervisors Vol. I & II – By National Safety council

3.	H. H. Fawcett, W. S. Wood, "Accident prevention in chemical plant operation", Inter science Publishers, 1965
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Year	III	CHL 3621 L: Health, Safety & Environment	Hours per week	2
			Credits	1
Semester	II	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	To study colour code and safety symbols	CHL 3621L	2, 3	CO1, CO2, CO4, CO5	PSO1, PSO2
2	To study personal protective equipment				
3	To study safety shower				
4	To study terms used in MSDS sheet.				
5	Measurement of noise level in working environment by sound level meter				
6	To study fire and fire extinguisher				
7	To study Portable gas monitor				
8	Study of COD in waste water				

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Diploma in Petrochemical Technology: Full Time (Regular)					
Year	III	CHL 3623: Process Instrumentation & Control	Max. Marks	IA	20
				UA	80
Semester	II	Core / Elective / Foundation	Hours per week		4
			Credits		4

Mode of Transaction : Lectures and Laboratory (4L + 2P)
Prerequisite : Applied Mathematics, Unit Operation, Unit Process, Plant Operation
Course Outcome (CO): CHL 3623 CO1 Select suitable sensing elements for the measurement of physical parameters. CO2 Understand the construction, working principle and application of various transducers used for measurement of different parameters. CO3 Convert process flow diagram to a process instrumentation diagram using standard symbols. CO4 Observe response of open loop, closed loop and multi loop control system with change in input variables to design control system. CO5 Discuss computer aided control systems.

Unit No.	Topic	Cont act Hou rs	Wei ghta ge (%)	BT Leve l	CO	PSO	Eleme nts of Employ ability (Emp.) / Entrepre neurship (Ent.) / Skill Develop ment (SD)	Releva nce to Local (L) / National (N) / Regiona l (R) / Global (G)	Relatio n to Gender (G) / Environ ment and Sustainab ility (ES) / Human Values (HV) / Professio nal Ethics (PE)
4.	<u>Characteristic of measurement system</u> Importance of instrumentation, Classification of instruments, Performance characteristics. methods of measurement, Functional elements of an instrument (block Diagram).	4	7	1, 2	CO1,	PSO1, PSO2	Emp., SD	G	PE
5.	<u>Temperature Measurement</u> Temperature scales, expansion and filled system thermometers, Thermoelectric temperature measurement, Radiation temperature measurement, Calibration of temperature measuring instruments, Selection of temperature sensors.	8	14	1, 2, 3	CO1, CO2	PSO1, PSO2	Emp., SD	G	PE
6.	<u>Pressure Measurement</u> Pressure scales, Pressure measurement equipment's: Liquid column element, Elastic elements, Electrical transducer, Force balanced devices, calibration of pressure measuring instruments, Maintenance and repair of pressure measuring instruments, Merits and demerits of pressure measuring instruments and their application.	9	16	1, 2, 3	CO1, CO2	PSO1, PSO2	Emp., SD	G	PE
7.	<u>Flow Measurement</u> Methods of flow measurement, variable head meters, variable areas meters, electromagnetic flow meter, Positive displacement flow meter, Velocity flow meter, Glow integrator, comparison and selection of flowmeter.	5	9	1, 2, 3	CO1, CO2	PSO1, PSO2	Emp., SD	G	PE

8.	<u>Measurement of head & level</u> Importance of level measurement, Methods of level measurement, Direct and Indirect methods, electrical methods: conductivity method, resistance method, capacitance method, ultrasonic method, radiation level detector <u>Miscellaneous Measurement</u> Density measurement, Viscosity measurement, Humidity measurement, pH measurement, Composition analysis	5	9	1, 2, 3	CO1, CO2	PSO1, PSO2	Emp., SD	G	PE
9.	<u>Process Dynamics</u> Dynamic behaviour of first order and second order system, Forcing functions, step, impulse, Ramp, sinusoidal Transfer, Function, Physical Examples, first order and second order system.	4	7	1, 2, 3, 4	CO1, CO4	PSO1, PSO2	Emp., SD	G	PE
10.	<u>Introduction to process control:</u> Incentives for chemical process control, aspects of process control system, Hardware for a process control system.	3	6	1, 2, 3	CO4	PSO1, PSO2	Emp., SD	G	PE
11.	<u>Open & Closed loop control systems:</u> Feedback, Inferential and feed forward control system, Servo Regulatory Control system, Development of block diagram	4	7	1, 2, 3	CO4	PSO1, PSO2	Emp., SD	G	PE
12.	<u>Process control application:</u> Process control in distillation column, Heat exchanger, Reactor. control valve, Classification, valve actuator, valve position, characteristics of control valves.	4	7	2, 3, 4	CO3	PSO1, PSO2	Emp., SD	G	PE
13.	<u>Feedback Control Systems & Control loops:</u> Types of control actions – P, PI, PD, PID, On-Off controller P, PI, PD & PID controllers. cascade control, Ratio control, selective controls, split range control, Adaptive Control.	7	12	1, 2, 3	CO4	PSO1, PSO2	Emp., SD	G	PE

14.	<u>Computer Aided Control Systems:</u> Elements of Computer Aided Control system. Basic function and Architectures of Computer Aided Control system. Analog to Digital signal conversion. Introduction of MMI, PLC, SCADA.	3	6	1, 2	CO5	PSO1, PSO2	Emp., SD	G	PE
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REFERENCES	
1.	A. Suryanarayana, “Outlines of chemical instrumentation & control”, Khanna Publishers, 3 rd Ed, 2008
2.	G. Stephanopoulos, “Chemical Process Control: An Introduction to Theory and Practice”, Prentice Hall India Learning Private Limited, 2008
3.	D.P. Eckman, “Industrial Instrumentation”, CBS, 2004
4.	S.K. Singh, “Industrial Instrumentation & control”, Tata McGraw, 2010
5.	A.P. Kulkarni, “Process Instrumentation and Control”, Nirali Prakashan, 2013

Year	III	CHL 3623 L: Process Instrumentation & Control	Hours per week	2
			Credits	1
Semester	II	Core / Elective / Foundation	Maximum Marks	50

No .	Experiment	Course Code	BT Level	CO	PSO
1	Calibration of K type thermocouple	CHL 362 3L	2, 3	CO1, CO2, CO3,CO4	PSO1, PSO2
2	Calibration of PT -100				
3	Calibration of Pressure gauge				
4	Relative viscosity study with Ostwald viscometer				
5	Speed of response of temperature measuring devices				
6	Dynamics of 1 st order system –liquid level				
7	Dynamics of non-interacting system				
8	Dynamics of interacting system				
9	Dynamics of 2 nd order system : Manometer				
10	Response of Controller				

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Diploma in Petrochemical Technology: Full Time (Regular)
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Year	III	CHL 3622: Polymers Technology and Processing	Max. Marks	IA	20
				UA	80
Semester	II	Core / Elective / Foundation	Hours per week		4
			Credits		4
Mode of Transaction : Lectures and Laboratory (4L + 2P)					
Prerequisite : Petrochemical Technology, Unit Processes, Unit operations					
Course Outcome (CO): CHL 3622					
CO1	Classify the polymers and its properties				
CO2	Recognize the basics of polymerization techniques and testing methods				
CO3	Comprehend bulk and engineering polymers with their production processes and application.				
CO4	Discuss synthesis of rubber, resin, and fibre products				
CO5	Use various polymer fabrication methods.				

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp.) / Entrepreneurship (Ent.) / Skill Development (SD)	Relevance to Local (L) / National (N) / Regional (R) / Global (G)	Relation to Gender (G) / Environment and Sustainability (ES) / Human Values (HV) / Professional Ethics (PE)
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1.	Introduction History, structure and classification of Polymer, polymer-based industries, and feedstock of polymer,	2	4	1,2	CO1	PSO1	Emp., SD	G	PE
2.	Types of polymerisation, mechanism of chain polymerisation and condensation polymerisation	5	9	1,2	CO2	PSO1	Emp., SD	G	PE
3.	Polymerization methods Bulk polymerization, Solution polymerization, Suspension Polymerization, emulsions polymerization	6	11	1,2	CO2	PSO1	Emp., SD	G	PE
4.	Chemical and geometrical structure of polymer Microstructure based on chemical structure, Microstructure based on geometrical structure, Introduction to polymer blends, state of polymer and transition temperature, Molecular Weight, and its determination.	6	11	1,2	CO1, CO2	PSO1	Emp., SD	G	PE
5.	Individual polymers Manufacturing process for the low-density Polyethylene, High density polyethylene, Linear Low-density polyethylene. Polyvinylchloride, polystyrene Polypropylene, Engineering Plastics-properties and uses (ABS, PMMA, TEFLON, Polycarbonates), Testing of plastic.	12	20	1,2,3	CO3	PSO1, PSO2	Emp., SD	G	PE
6.	Rubbers and fibres Classification, properties and manufacturing process, spinning process, testing methods.	7	12	1,2,3	CO4	PSO1, PSO2	Emp., SD	G	PE
7.	Resins Classification, properties, polyamides resins, epoxy resin, acrylic resin, polyurethane	4	7	1,2,3	CO4	PSO1, PSO2	Emp., SD	G	PE
8.	Processing of plastic and rubber: Processing of thermoplastics and thermosets, recent developments in processing of plastics	10	18	1,2,3	CO5	PSO1, PSO2	Emp., SD	G	PE
9.	Quality control Identification of plastics, Testing of plastics.	4	7	1,2,3	CO5	PSO1, PSO2	Emp., SD	G	PE

REFERENCES

1.	V. R. Gowariker, "Polymer Science", New Age International Publishers, ed. 3rd, 2019
2.	F.W. Billmeyer, "Textbook of Polymer Science", Wiley-Interscience, ed. 3rd, 1984
3.	I.D. Mall, "Petrochemical process technology", Laxmi publications, 2017

Year	III	CHL 3622 L: Polymers Technology and Processing	Hours per week	2
			Credits	1
Semester	II	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	Analysis of formaldehyde: determination of Acidity, Assay & methanol Content	CHL 3622L	2, 3	CO1, CO2,CO4 CO5	PSO1, PSO2
2	Analysis of phenol by bromination method				
3	Analysis of cellulose acetate: determination of Moisture, Acidity & acetyl content				
4	Identification of common plastics by simple test				
5	Determination of water content in given crude sample by dean & Stark method				
6	Analysis of DMT: Determination of saponification equivalent and acid number				
7	Determination of melt flow index of given sample of plastics.				
8	Study of extrusion process.				
9	Study of Injection moulding process.				

10	Study of Hot stamping process.				
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Diploma in Petrochemical Technology: Full Time (Regular)		

Year	III	CHL 3614 L: Chemical Engineering Drawing	Max. Marks	IA	00
			UA	50	
Semester	II	Core / Elective / Foundation	Hours per week		3
			Credits		3
Mode of Transaction : Laboratory (3 TW/VIVA)					
Prerequisite : Petrochemical Technology, Unit Processes, Unit operations					

Course Outcome (CO): CHL 3614L

- CO1** Understanding of symbols and their significance in the Chemical and Process Industries
- CO2** Draw and understand various types of Heat Exchanger and TEMA standards.
- CO2** Learn to draw , understand and interpret Process and Instrumentation diagrams and equipments as per the different codes/ requirements .
- CO3** Drawing and analysis of basic control systems with different configuration in the Chemical and Process Industries

Year	III	CHL 3614 L: Chemical Engineering Drawing	Hours per week	2
			Credits	1
Semester	II	Core / Elective / Foundation	Maximum Marks	50

No.	Experiment	Course Code	BT Level	CO	PSO
1	Symbols used in Process Flow Diagram	CHL 3614 L	1,2,3	CO1 CO2 CO3 CO4	1,2
2	Symbols used in Piping & Valve				
3	Symbols used in Instrumentation and Control				
4	Utility line Diagram				
5	Plate & Packed Column Details				
6	Different types of Agitator				

7	Typical Control system				
8	TEMA Table				
9	Heat Exchanger Details				
10	Different Heat Transfer Jacket arrangement				
11	Pressure Vessel				

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Year	III	CHL 3619 L: Project Work - II	Hours per week	3
			Credits	3
Semester	II	Core / Elective / Foundation	Maximum Marks	100

Prerequisite : Basic Computer Practice, Unit Operation , Unit Processes, Plant Operation, Process Control
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Course Outcome (CO): CHL 3619 L

- CO1** Conduct literature survey for a selected product and include a market survey of the same
- CO2** Carry out the material and energy balances for the process
- CO3** Design of Equipment and drawing of plant layout of the process
- CO4** Understand MSDS and its importance and draw the PID diagram of selected process
- CO5** Prepare written report and present the same using Power Point

No.	Topic		Course Code	BT Level	CO	PSO
1	Introduction (a) Objective (b) Application including market survey on given chemical compound.		CHL 3619L	1,2,3,4	1	1,2
2	Properties (a) Raw material (b) Products (c) By-products				1	
3	Chemistry / Mechanism of the process.				1	
4	Different processes used in the industry				1	
5	Selection of the process technology				1	
6	Description of the process selected.				1	
7	Material balance / Energy balance - simple calculation for production of It on some basis.				2	
8	Simple Equipment design - Calculation of height, diameter, thickness of Any one of the major chemical equipment and its detailed drawing.				2	
9	Operation: Operation of chemical plant, start up, shutdown procedure, Maintenance aspect.				3	

10	Safety of the process equipment.				4	
11	Process Instrumentation Diagram - Instrumentation and process control				2	
12	Details of any one of the major chemical equipment.				2	
13	Cost estimation.				2	
14	Entrepreneurship and management aspect of the project.				3	
15	Conclusion (a) Results (b) Usefulness in the industry (c) Interpretation.				1,2,3,4	
16	List of references				1	