Course Curriculum

Session – 2022- 2025

Three Year Diploma Course

In

Chemical Engineering

Second Year

GLA UNIVERSITY POLYTECHNIC

COURSE STRUCTURE, CONTACT HOURS and CREDITS

DISCIPLINE : CHEMICAL ENGINEERING
SEMESTER : III (FULL-TIME)

Sr. No.	Subject Code	Subject Name	Periods Per Week			Cr
			L	T	P/D	
1	DCH-3101	Fluid Mechanics	3	0	0	3
2	DCH-3102	Chemical Process Calculations	3	0	0	3
3	DCH-3106	Mechanical Operations	3	0	0	3
4	DCH-3004	Basics Of Electrical And Electronics Engineering	3	0	0	3
5	DCH-3105	Mass Transfer – I	3	0	0	3
6	DCH-3081	Mass Transfer – I Lab	0	0	4	2
7	DCH-3082	Fluid Mechanics Lab	0	0	4	2
8	DCH-3083	Basics Of Electrical And Electronics Engineering Lab	0	0	2	1
9	DCH-3090	Field Visits & Presentations-I	0	0	2	1
10	DCH-3091	General Proficiency	0	0	0	1
TOTAL			**15**	**0**	**12**	**22**

L- Lecture Period, **T**-Tutorial Period, **P**- Practical Period, **D**- Drawing Practice Period, **Cr**. - Credits,

DCH 3001: FLUIDMECHANICS

Credits: 3 **Semester III** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
Module –I	**Properties of Fluid**: density, viscosity, vapor pressure, surface tension, hydrostatic equilibrium. Types of flow – steady, non-steady, uniform, non-uniform, streamline, laminar and turbulent flow, rotational, irrotational flow. **Types of fluid:** compressible and incompressible fluid, Newtonian and non- Newtonian fluid. Fluid statistics - Pascal's law, hydrostatic law, various types of manometers: U tube manometer and differential manometer. Continuity equation, Bernoulli's theorem, **flow through pipes and open channels**: Hagen poiseulli's equation, friction factor charts, friction losses in pipes, friction loss from sudden enlargement and contraction, effect of roughness in pipes.	21
Module– II	Simple numerical problems related to the above topics. **Flow measurement**: flow through venturimeter, orifice meter, flow nozzle, pitottube, rotameter. **Pump**: Classification of pumps, construction and working of reciprocating pump, centrifugal pump and rotary pump, priming and NPSH, cavitation, power requirement, efficiency of centrifugal pump, specific speed. Blowers and compressors. **Pipe and Fittings**: Different types of pipes, schedule Number, ID and OD of pipe, colour coding of industrial piping used for transportation of various fluids, different types of valves and fittings: Globe valve, Butterfly valve, Gate valve, Ball valve and Needle valve.	21

RECOMMENDED BOOKS

1. Unit Operations of Chemical Engineering by McCabe W.L. & Smith J.C. McGraw Hill.
2. Chemical Engineering Hand Book by Perry K. Chilton.
3. Chemical Engineering Vol.I and II by Coulson and Richardson. Pergamota Press Publications.
4. Introduction to Chemical Engineering by Bedger and Banchero, McGraw Hill Publication.
5. Principles of Unit Operations by Alen Foust, John Willey Publicaiton.
6. Chemical Engineering Fluid Mechanics by K.A. Gavahane, Nirali Publications.

DCH-3002: CHEMICAL PROCESS CALCULATIONS

Credits: 3 **Semester III** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
Module –I	**Introduction:** Definition of Chemical Engineering with brief history, future and career opportunities for chemical engineers. Difference between Unit Operations and Unit Processes. Units and dimensions, inter conversion of units of pressure, volume, force, work, energy, viscosity, temperature, specific gravity and heat in SI, CGS, MKS and simple numerical problems. Boyle's law, Charle's Law, Ideal gas equation, Dalton's law, Amagat'slaw, Relation between Vol% = Mole% = Press%, Average molecular weight of gas mixture, Density of gas mixture and simple numerical problems. Concept of mole, gm moles, gm atoms, mole fraction and concentration of solution in different ways like molarity, molality and normality, mass%, mass fraction, volume%, volume fraction. **Material balance without chemical reaction:** Definition and meaning of material balance, basic steps to be followed in the material balance calculation, numerical problem based on material balance without chemical reaction	21
Module-II	Unit operations like distillation**,** drying, evaporation, meaning of by bass, recycle and purge system of material balance. **Material balance with chemical reaction:** Limiting component, excess component, percent conversion, percent yield. **Energy balance:** Definition and meaning of energy balance, standard heat of reaction, and formation,sensible heat, latent heat, heat capacity at constant pressure, relation between CpandCv, standard heat of reaction: heat of formation and heat of combustion, Hess'slaw of constant heat summation.	21

RECOMMENDED BOOKS

1. Solved Example in Chemical Engineering by G.K. Roy, Khanna publication.
2. Chemical Process Principles by Hougen and Watson, Wiley International Edition.
3. Stoichiometry by Bhatt and Vohra,Tata McGraw Hill Publicaiton.
4. Basic Principles and Calculations in Chemical Engineering Himmelblaw, Prentice Hall Publication.
5. Stoichiometry by K.A. Gavhane, Nirali Publishers

DEE 3004: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Credits: 03 **Semester III** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Basic Electrical:** Quantities, Definition of voltage, current, power and energy with their units, name of instruments used for measuring above quantities. Difference between AC and DC, various applications of electricity, advantages of electrical energy over other types of energy. Production of emf, idea of a transformer and its working principle. **Basic Electronics Basic idea of semiconductors** – P and N type; diodes, zener diodes and their applications, transistor – PNP and NPN, symbols, identification of terminals of transistor, current flowing in a transistor, its characteristics and uses. Characteristics and applications of a thyristor Transmission and Distribution System Key diagram of 3 phase transmission and distribution system, Brief functions of Accessories of transmission line. Difference between high and low voltage distribution system, identification of three-phase wires, neutral wire and earth wire in a low voltage distribution system. Identification of voltages between phases and between one phase and neutral	21
II	**Electric Motors and Pumps** Definition and various applications of single-phase and three-phase motors. Connection and starting of three-phase induction motors by star-delta starter. Conversion of horse power in watts or kilowatts, Type of pumps and their applications, difference between direct online starter and star delta starter, characteristics and applications of servo motors. Electrical Safety Electrical shock and precautions against shock, treatment of electric shock, concept of fuses and their classification, selection and application, concept of earthing and various types of earthing, applications of MCBs and ELCBs. Introduction and applications to inverter and generators.	21

RECOMMENDED BOOKS

1. Basic Electrical Engineering by PS Dhogal; Tata McGraw Hill Publishers, New Delhi
2. A Text Book of Electrical Technology, Vol. I and II by BL Thareja; S Chand and Co., New Delhi
3. Basic Electricity by BR Sharma; SatyaPrakashan, New Delhi
4. Basic Electrical Engineering by JB Gupta, S Kataria and Sons, Delhi
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi
6. Basic Electronics by VK Mehta; S Chand and Co., New Delhi

7. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi

DCH 3005-MASS TRANSFER - I

Credits: 3 **Semester III** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Diffusion** Definition of diffusion and its classification (Forced diffusion, Eddy diffusion etc.), Fick's law, Flux equation, molecular diffusion in gases, steady state equimolar counter diffusion, Mass transfer coefficient, film theory and penetration theory of mass transfer, diffusion in solids. **Gas Absorption** Concept of absorption, choice of solvent, effect of temperature and industrial applications, condition of equilibrium between gas and liquid, mechanism of absorption, concept of transfer unit (HTU and NTU), gas absorption equipments. **Crystallization** Study of various factors affecting crystallization. Crystal growth, size and shape variation of different materials during crystallization. Types of crystallizers.	21
II	**Humidification** Definition and calculation of Humidity, Percentage humidity, Relative humidity, Humid volume and Humid heat. Enthalpy and its calculation, Dry bulb and wet bulb-temp, Adiabatic saturation temperature, Use of humidity chart, Dew point, simple numerical problem using humidity chart, construction and description of cooling towers (Natural and induced draft). **Evaporation** Definition, types of evaporation equipment's, overall heat transfer coefficients in evaporators, single and multiple effect evaporators, evaporation of biological materials. **Drying** General drying behaviour-Critical moisture content, equilibrium moisture content, bound and unbound moisture, free and critical moisture content rate of drying, time of drying, types of dryers.	21

Books:

1. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
2. Sherwood T. K., Pigford R. L. and Wilke P. "Mass Transfer" McGraw Hill (1975)
3. Foust A. S. et. al., "Principles of Unit Operations" John Wiley (1980).
4. Geankoplis, C. J. "Transport Processes and Unit Operations", 3rd ed. Prentice Hall. (1993)
5. Richardson & Colson, Volumes - I, II, IV, V
6. Sinha A. P. &Parameswara De "Mass Transfer Principles and Operations" PHI New Delhi

DCH3006-MECHANICAL OPERATIONS

Introduction: To study of various unit operation used in chemical industry like crushing, grinding, screening, sedimentation, classification and mixing operation.

Objective: it is designed to make students aware about the various types of size reduction techniques, the power required for size reduction. Also use of various equipment used for size reduction and separation techniques and their application in cement, sugar, pulp and paper, fertilizer, ceramic industry.

Credits: 3 **Semester III** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Particulate solids**: Characterization of solid particles, particle shape, particle size, mixed particle sizes and size analysis, specific surface of mixture, average particle size. Screen analysis: Type of screens, ideal screen, real screen, screen effectiveness, differential and cumulative analysis, screen capacity. **Screening equipment**: stationary screens and grizzlies, gyrating screens, vibrating screens and other industrial screens like trammels etc. **Transportation and storage of solids**: Studies on design, performance and operation of different conveyor systems like Belt, Screw, Apron, Flight, pneumatic conveyor and elevators; Storage of solids and discharge pattern from storage bin, theory and measurement of granular solid flow through orifice. **Comminution of solids (Size Reduction**): Factors affecting comminution, comminution laws: Kick's law, Rittinger's law and Bond's law and their limitations. Crushing efficiency & power consumption. Size reduction equipment's : Primary crusher – Jaw crusher, Gyratory crusher, Secondary crusher – Roll crusher (both smooth roll & toothed roll) its selection and capacity,	21
II	Grinder – Construction and operation of Hammer mill, Ball mill, Rod mill, Attrition mill, Agitated mill and their materials suitability, Ultra-fine grinder – Fluid energy mill, Cutting machines: knife cutters, Close circuit and Open circuit operation. **Separation based on particle Mechanics through liquids**: Free settling and Hindered settling, Stock's law & Newton's law regimes of settling, Gravity settling processes, gravity classifiers, sorting classifiers: sink-and-float methods, differential settling methods. Clarifiers and thickeners, flocculation, batch sedimentation, rate of sedimentation. Equipment for sedimentation: thickeners. Clarifier and thickener design, sedimentation zones in continuous thickeners. Cyclones, hydro cyclones, centrifugal decanters. **Mixing:** Units and dimensions, dimensional analysis: Buckingham's theorem, Principles of agitation, agitation equipment, flow patterns: prevention of swirling/vortex, draft tubes, Standard turbine design, power consumption, power correlation, significance of dimensionless groups, effect of system geometry, calculation of power consumption in Newtonian liquids. Solid-solid mixing equipment, Mixing effectiveness and Mixing index. Agitator scales up. Froth Flotation: Theory, operation, types,	21

	Flotation agents, and Flotation cells.	

Text book

1. Narayanan C.M.& Bhattacharya B.C. “Mechanical operations for chemical engineers”, Khanna.
2. Unit Operations of Chemical Engineering: McCabe and Smith, TMC.

REFERENCE BOOKS

1. Badger and Bencharo, “Introduction to Chemical Engineering”. TMH,
2. R. S. Hiremath & A.Kulkarni. Mechanical Operations Vol.I

Intended Outcomes:

- Student able to understand the various concepts of size reduction like crushing, grinding, milling and their industrial applications.
- Student can also understand about separation of solid from solid phase or liquid phase by using various techniques.
- Students can able to design various size reduction equipment, classifiers, sedimentation and mixing equipments by using these techniques.

DCH 3081-MASS TRANSFER – I LAB.

Credits: 2 **Semester III** **L-T-P: 0-0-4**

List of Practical

Module No.	Contents	Teaching Hours
1	Determination of diffusivity of acetone in air.	48
2	Determination of mass transfer coefficient in an agitated vessel.	
3	Determination of mass transfer coefficient for steady state surface evaporation of water at different temperature.	
4	Determination of mass transfer coefficient in a wetted wall column.	
5	Determination of T-x-y diagram for a binary batch distillation.	
6	Verification of Rayleigh equation in a binary batch distillation process.	
7	Verification of steam distillation equations.	

DCH-3082: FLUID MECHANICS LAB.

Credits: 2 **Semester III** **L-T-P: 0-0-4**

List of Practical

Module No.	Contents	Teaching Hours
1	Experiments on Reynolds Apparatus for determination of flow regime and construction of Fanning friction factor vs. Reynolds No. plot.	48
2	Determination of co efficient of Discharge for Orifice meter.	
3	Determination of co efficient of Discharge for Venturi meter.	
4	Determination of co-efficient of Pitot tube and construction of velocity profile across the cross section of pipe.	
5	Determination of co-efficient of Discharge for different types of weirs.	
6	Determination of pressure drop for flow through packed bed and verification of Ergun equation.	
7	Experiment on fluidization techniques and determination of (a) Minimum fluidization velocity; (b) Pressure drop profile.	
8	Determination of efficiency of a centrifugal pump.	
9	Pipe line assembling and a layout drawing with standard symbols.	
10	Calibration of a Rotameter.	
11	Determination of viscosity of Newtonian &Non-Newtonian fluid by Falling Sphere method.	

DCH-3083: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LAB

Credits: 02 **Semester III** **L-T-P: 0-0-2**

Module No.	Contents	Teaching Hours
1	To change the speed and direction of rotation of d.c. shunt motor by (a) Armature control method. (b) Field control method.	24
2	To change the speed and direction of rotation of d.c. compound motor by (a) Armature control method. (b) Field control method.	
3	To measure the terminal voltage with variation of load current of (a) D.C. shunt generator. (b) D.C. compound generator.	
4	To perform load test on a single phase transformer and determine its efficiency.	
5	To start and run a induction motor by (a) Star Delta Starter. (b) Auto Transformer Starter.	
6	To measure slip of an induction motor by direct loading.	
7	To start and change the direction of rotation of an induction motor.	
8	To measure transformation ratio of a single phase transformer.	
9	To measure power and P.F. in a single phase circuit by Ammeter, Voltmeter and Wattmeter.	
10	To measure power and P.F. in a 3 phase/A.C. circuit by two wattmeter method.	
11	To calibrate a single phase energy meter at different P.F.'s and different loads.	
12	To locate the faults in an electrical machine by a megger.	
13	To connect a fluorescent tube and note its starting and running current.	
14	To draw characteristics od Silicon Controled Rectifier (SCR).	
15	Testing of electrical devices - Zenor, Diode, Transistor, FET, UJT, SCR.	
16	Use of operational amplifier as adder, substractor, comparator, differentiator and integrators.	
17	Repair and maintenance of inverters and generators.	

ANNEXURE – C

GLA UNIVERSITY POLYTECHNIC

COURSE STRUCTURE, CONTACT HOURS and CREDITS

DISCIPLINE : CHEMICAL ENGINEERING

SEMESTER : IV (FULL-TIME)

Sr. No.	Subject Code	Subject Name	Periods Per Week			Cr
			L	T	P/D	
1	DCH-4101	Mass Transfer – II	3	0	0	3
2	DCH-4102	Chemical Engineering Thermodynamics	3	0	0	3
3	DCH-4103	Heat Transfer	3	0	0	3
4	DCH-4106	Introduction To Engineering Materials	3	0	0	3
5	DCH-4105	Chemical Reaction Engineering	3	0	0	3
6	DCH-4081	Mass Transfer - II Lab	0	0	4	2
7	DCH-4082	Heat Transfer Lab	0	0	2	1
8	DCH-4083	Chemical Reaction EngineeringLab	0	0	4	2
9	DCH-4090	Field Visits & Presentations-I	0	0	4	2
10	DCH-4091	General Proficiency	0	0	0	0
TOTAL			**15**	**0**	**08**	**22**

L- Lecture Period, **T**-Tutorial Period, **P**- Practical Period, **D**- Drawing Practice Period, **Cr**. - Credits,

DCH-4001: MASS TRANSFER–II

Introduction: To study about the various mass transfer operations like distillation, extraction (Liquid – Liquid), leaching, adsorption and ion exchange etc.

Objective:it is designed to make students aware about the distillation process of binary and multi- component mixtures and also extraction, leaching, adsorption and ion-exchange process and their application used in chemical industry.

Credits: 3 **Semester IV** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Distillation** Vapour liquid equilibrium, pressure, temperature, concentration diagram, relative volatility, ideal solutions, Raoult's law, flash vaporization, differential or simple distillation (Rayleigh equation), steam distillation, vacuum distillation, principles of rectification, binary system, material balance and energy balance for fractionating column, calculation of ideal stages by McCabe Thiele method, introduction of feed, location of feed tray, minimum reflex ratio and infinite reflux ratio, optimum reflux ratio, condenser and reboiler heat duty, types of trays, tray efficiency. **Extraction (Liquid – Liquid)** Definition –Field of usefulness, properties of solvent, solvent requirement equilateral triangular diagram, effect of temperature and press on solubility diagram, stage wise contact, and calculation for single stage, extraction and multistage extraction equipments	21
II	**Leaching** Definition of various terms, preparation of solid methods of operation, calculation for single and multistage leaching, stage efficiency, equipments. **Adsorption and ion exchange** Definition, Industrial application, types of adsorption, adsorption equilibrium, equilibrium adsorption of single Vapour& gas mixture in brief, adsorption in liquids, Adsorption of solute from dilute solution, Freundlich equation & its scope, nature of adsorption, examples, properties and application of typical adsorption, adsorption operation of various equipments. Ion Exchange, principles, use of Ion exchange in D.M. water.	21

Text Books:

1. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980)
2. Sinha A. P. &Parameswar De "Mass Transfer Principles and Operations" PHI New Delhi
3. Mass Transfer Operations by Kiran D. Patil, Nirali Publication

4. Chemical Engineers Handbook by Perry and Chilton, McGraw Hill Publication

Ref Books:

1. Sherwood T. K., Pigford R. L. and Wilke P. “Mass Transfer” McGraw Hill (1975)
2. Geankoplis, C. J. “Transport Processes and Unit Operations”, 3rd ed. Prentice Hall. (1993)
3. Richardson & Colson, Volumes - I, II, IV, V
4. Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication

Intended Outcomes:

- Student would be aware about various mass transfer operations.
- Student can also able to understand various separation techniques like distillation, extraction (Liquid – Liquid), leaching, adsorption and ion exchange etc and rate of mass transfer.

DCH-4002: CHEMICAL ENGINEERING THERMODYNAMICS

Introduction: To study of various sources, concept of energy, work, heat & their conversion, thermodynamics and study of various thermodynamic laws with their applications.

Objective: Know various sources of energy & their applications by applying various gas laws & ideal gas processes to various thermodynamic systems and understand the properties of steam. Student can also aware about behaviors of fluids with temperature and pressure in refrigeration and liquefaction process.

Credits: 3 **Semester IV** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction and Basic Concepts** Scope of Thermodynamics, open & closed system. Thermodynamic properties-Temperature, Volume, Pressure, Specific heat atconstant volume, Isothermal &Adiabatic process, irreversible & reversible process, Intensive & Extensive properties. Thermodynamic system, properties and state of a substance, processes and cycle, equality of temperature, Zeroth law of thermodynamics. The pure substance, phases of a pure substance, phase rule independent properties of a pure substance, equation of state for vapor phase (Wonder Wall Equation). **First law of thermodynamics**: Formation of 1st law of thermodynamics, state and path functions, thermodynamic systems, steady state flow system, phase rule, reversible process heat capacity. **Second law of thermodynamics**: Limitations of First Law, Statements of second law, analysis of Carnot cycle, ideal and actual engine efficiencies, various thermodynamic cycles, power cycles with external combustion or heat pump cycles, power cycles with internal combustion,	21
II	**Entropy**: Inequality of classius, entropy - a property of a system, entropy change in reversible process, entropy change for an open system, principle of increase of entropy, efficiency, irreversibility and availability, simple numerical problem for calculation of entropy change, thermodynamic relations. **Third law of Thermodynamics**: Free energy and work function, Fugacity and Fugacity coefficient, activity and activity coefficient, Helmholtz free energy functions, Gibbs free energy, criteria of spontaneity, Gibbs-Helmholtz equation at constant pressure in terms of free energy and enthalpy change, Gibbs-Helmholtz equation at constant volume in terms of work function and internal energy change. Clausius- Clapeyron equation, Maxwell relations, Chemical potential, Gibbs-Duhem equation – variation of chemical potential with temperature and pressure. **REFRIGERATIONS &LIQUEFACTION** : The Carnot refrigeration cycle, the air refrigeration cycle, vapor compression cycle, Absorption refrigeration-flow diagram and their descriptions; coefficient of performance (C.O.P), liquefaction process, latest refrigerant and their qualities and	21

	applications.	

Text book:

1. Introduction to Chemical Engineering Thermodynamics by Smith and Vanness, McGraw Hill.
2. Chemical Engineering thermodynamics by K.V. Narayanan, Prentice Hall India.
3. Chemical Engineering Thermodynamics by YVC Rao
4. Chemical Engineering Thermodynamics by K.A. Gavhane, Nirali Publication

Reference books:

1. Engineering Thermodynamics by PK Nag
2. Thermal Engineering by Ballaney
3. Chemical Engineering Thermodynamics by Dodge, McGraw Hill.

Intended Outcomes:

- Student would be aware about various thermodynamic properties and their uses in various process industries.
- Student can also able to understand various laws of thermodynamic and their application, properties, properties of steam.
- Student can also understand about behaviors of fluids with temperature and pressure in refrigeration and liquefaction process.

DCH-4003: HEAT TRANSFER

Introduction: To study of various modes of heat transfer such as thermal conduction, thermal convection, thermal radiation, and transfer of energy by phase changes.

Objective: Know various modes of heat transfer & their applications in design of heat exchanger, evaporators and cooling tower. Student can also aware boiling and condensation process in detail.

Credits: 3 **Semester IV** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Definition and Modes of heat transfer. **Conduction:** thermal conductivity, Fourier's law of heat conduction, Steady and unsteady state equation, heat flow equation for flat wall, multilayer flat wall, composite walls, Composite cylinders, Spheres, Optimum insulation thickness **Convection**: Natural and forced convection, physical significance of dimension less number, Reynold No., Prandtl No., Nusselt No., Stanton No., Peclet No., Grashoff No., Dittus Boelter's equation-simple numerical problems using Dittus Boelter equation, Fouling factor, Individual heat transfer coefficient and over all heat transfer coefficient. **Radiation**: Reflection, absorption and transmission of radiation, Kirchhoff law, Emissive power, Wein's displacement law, the Stefan Bultmann law, Heat transferred by radiation exchange of energy between two parallel planes of difference emissivity, Radiant Heat transfer coefficient, Solar radiation, grey surfaces or grey body. **Boiling** Nuclear boiling, film boiling, Transition boiling, Maximum flux and critical temperature drop, construction & description of Kettle type boilers. Boiling point rise (B.P.R) and effect,	21
II	**Heat Exchangers** LMTD, (L.M.T.D.) for parallel or co-current - flow, counter-current-flow, cross - flow, construction and description of 1. Double pipe heat exchangers. 2. Shell & Tube heat exchanger. 3. Finned tube heat exchangers. Scale formation and cleaning devices. 4. Plate type heat exchangers. **Condensers** Concept of condensation, Film-wise and Drop-wise condensation. Types of condensers **Evaporators** Evaporation capacity, evaporation economy, types of evaporators; open pan, longtube vertical evaporator, falling films, forced circulation, feeding arrangement, concept of multiple effect evaporation. Furnaces and its classifications.	21

Text book

1. Process Heat Transfer by Kern DQ, McGraw Hill Book, New York
2. Heat Transfer Principles and Applications by K Dutta; Prentice Hall, India.
3. Heat Transfer by K.A. Gavhane, Niral Publicatins.

Reference books:

4. Heat Transfer 7th Ed. By Holman JP; McGraw Hill, New York
5. Applied Process Design for Chemical and Petrochemical Plants, Volume III by Ludwig, E; Gulf Publishing Co., Houston, Texas

Intended Outcomes:

- Student able to understand the various modes of heat transfer & their applications in design of heat exchanger, evaporators and cooling tower.
- Student can also understand the boiling and condensation process in detail and their application different process industries.
- Students can able to understand the heat transfer applications in industrial production. 99% of manufacturing uses some process to transfer heat. Cooling, heating, humidifying and dehumifying. Drying processes are the common examples of heat transfer.

DCH 3006-INTRODUCTION TO ENGINEERING MATERIALS

Credits: 3 **Semester IV** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
Module –I	**Importance Of Engineering Materials** Classification of engineering materials and their use in chemical industries, structure property relationships in materials. Introduction to determination of mechanical properties of materials ASTM methods. **Mechanical, Thermal And Electrical Properties** Tensile strength, compressive strength, shear strength, ductility and malleability, methods of improving strength; specific heat, glass transition temperature, crystalline melting temperature; thermal conductivity,dielectricstrength, dielectric constant, power loss and electrical diffusivity. Testing of materials, destructive and non-destructive tests, structure of atom and chemical bonds, crystal structures and their influence on material properties, deformation and slip processes. Specification of materials according to BIS **Ferrous Metals** Important varieties of iron ores, cast iron; types, properties andusesof cast iron, pig iron: types of pig iron. Wrought iron: properties anduses of wrought iron; Steel: factors affecting physical properties ofsteel and uses of steel (no manufacturing process)	21
Module-II	**Non-Ferrous Metals** Aluminum, copper, lead, nickel, tin and zinc, their properties anduses, various alloys of aluminum, copper, nickel and steel. Study of phase diagram of Fe-C, Classification of stainless steels, properties and uses. Non-metallic materials **Polymers-**Nylon–66, nylon – 6, polyesters, polycarbonates,polyurathanes,LDPE, HDPE PVC, Polypropylene, rubber. **Ceramics -** Definition of ceramic, clays, properties of clay, earthen wares andstone wares, uses of stoneware's. **Glass -** Definition, classification, composition, types and properties of glass. **Nano Materials–** Classification, synthesis, characterization and application of Nano materials – Bucky balls, carbon nano tubes, fullerities. Nano particles – silver nano particles. Applications of Nano materials in chemical industry.	21

RECOMMENDED BOOKS

1. Materials in Industry by WJ Patton; Prentice Hall Publication
2. Introduction to Engineering Materials by Aggarwal; Tata McGraw Hill Publication
3. Material Science by Narula; Tata McGraw Hill Publication

4.Elements of Mettalurgy by HS Bawa; Tata McGraw Hill Publication

DCH-4005: CHEMICAL REACTION ENGINEERING

Introduction: To study of various concepts of chemical reaction engineering like molecularity, order of reaction, rate constants, types of reactions, use of catalyst and types of reactors used in chemical process industries.

Objective: it is designed to make students aware about the concept of chemical reaction engineering. types of reactors used in chemical industries and their working.

Credits: 3 **Semester IV** **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Definition of reaction rate; Kinetics of homogeneous reaction: Concentration-dependent term of a rate equation, single and multiple reactions, rate equation from given mechanisms. Elementary & Non elementary reactions, Molecularity and order of reaction, Representation of reaction rate, Kinetics for non-elementary reactions, related problems, Temperature dependent term of a rate equation: Arrhenius law, Collision theory, Transition state Theory, related problems; Interpretation of batch reactor data: Constant-volume batch reactor, Integral method of analysis of data: General Procedure, Irreversible unimolecular-type first-order reaction, Irreversible bimolecular-type second-order reactions, rate equation for enzymatic reaction, Zero-order reactions, Over-all order of irreversible reactions from the Half-life method, Initial rate method of analysis. Irreversible Reactions in parallel, Autocatalytic reactions, Irreversible reactions in series, First-order Reversible Reactions, Differential method of Analysis of data: Analysis of the Complete Rate Equation, Partial analysis of rate equation, Variable-Volume reaction system: Its Integral method of analysis for Zero-order reactions, First order reaction, Second-order reactions; **Single ideal Reactors**: Introduction; Basic division of ideal reactors, Ideal Batch Reactor, Concept of flow reactors, Space-time and Space-velocity, Steady-state Mixed Flow Reactor: Design Equation, Graphical Representation of Design Equation, related problem;	21
II	Steady-state Plug Flow Reactor: Design equation, graphical representation, related problem;, Design for Single Reactions: Size and comparison of single reactors: Batch Reactor, PFR, MFR, General Graphical Comparison; **Multiple-Reactor Systems**: PFRs in Series and/or in Parallel, Equal-size MFRs in Series, MFRs of different sizes in Series, Determining the best size combination of reactor size for a given combination, Reactors of Different Types in Series, Recycle Reactor: Definition of Recycle Ratio, Design Equation, and Optimum Recycle ratio. Distribution of Residence Times for Chemical Reactors: General Characteristics; Residence-Time Distribution (RTD) Function; **Measurement of the RTD:** Pulse Input; Related problems; Characteristics of RTD: Integral Relationships, Mean Residence Time, Different Moments of RTD; RTD in Ideal Reactor: RTD in Batch and PFR, Single CSTR, PFR/CSTR	21

	series RTD; Concept of Macromixing&Micromixing, Zero Parameter Model: Segregation Model & Maximum Mixedness Model. Models for Non-ideal Reactors: Introduction; One-Parameter Models: Tanks in Series Model, Dispersion Model: Basic Formulation, Definition of Peclet Number & Vessel Dispersion Coefficient, Boundary Conditions (Closed-Closed & Open-Open), Correction for Sloppy Tracer Input, Relation between Flow, Reaction and Dispersion	

RECOMMENDED BOOKS

1. Chemical Reaction Engineering, 2nd. & 3rd. editions, O Levenspiel.: Wiley Eastern Ltd.
2. Chemical Engineering Kinetics and Reactor Design, C.G. Hill, Wiley

Intended Outcomes:

- Student able to understand the various concepts of chemical reaction engineering like molecularity, order of reaction, rate constants, types of reactions, use of catalyst and types of reactors used in chemical process.
- Student can also understand about distribution of residence required for chemical reactors like batch, CSTR, PFR etc.
- Students can able to design various types of reactors in series and in parallel.

DCH-4081: MASS TRANSFER – IILAB.

Introduction: To study about working of various types of equipments/instruments related to mass transfer operations.

Objective: To give the hand-in-hand experience of lab-scale experiments on various types of mass transfer equipment based on the theoretical understanding and its application learned in theory course.

Credits: 2 **Semester IV** **L-T-P: 0-0-4**

List of Practical

Module No.	Contents	Teaching Hours
1	Determination of ternary curve for the system acetic acid-water-carbon tetrachloride.	48
2	Determination of distribution coefficient of a solute in two immiscible liquids.	
3	Solid-Liquid extraction – Soxhlet's experiment.	
4	Liquid - liquid extraction in packed bed.	
5	Determination of adsorption kinetics and isotherm at solid-liquid interface.	
6	Determination of the rate of drying in a tray dryer.	
7	Estimation of efficiency of the fluidized bed dryer	

Intended Outcomes:

- To understand the separation of component by extraction process.
- To able to calculate adsorption kinetics and isotherm in adsorption process for the given components.
- To able to calculate adsorption kinetics and isotherm in adsorption process for the given components.
- To able to understand about working and efficiency of fluidized bed dryer and tray dryer.

DCH-4082: HEAT TRANSFER LAB.

Introduction: To study about working of various types of equipments/instruments related to heat transfer operations.

Objective: To give the hand-in-hand experience of lab-scale experiments on various types of heat transfer equipment based on the theoretical understanding and its application learned in theory course.

Credits: 2 **Semester IV** **L-T-P: 0-0-2**

List of Practical

Module No.	Contents	Teaching Hours
1	To study heat transfer through lagged pipe.	24
2	To find out the thermal conductivity of liquid.	
3	To study heat transfer in composite wall and find equivalent thermal conductivity.	
4	To find out the convective heat transfer co-efficient of vertical cylinder in natural convection.	
5	To determine convective heat transfer coefficient in forced convection.	
6	To find out the overall heat transfer co-efficient of a double pipe heat exchanger.	
7	To find out the overall heat transfer co-efficient of 1-2 shell & tube heat exchanger.	
8	To study the heat transfer coefficient during drop wise and film wise condensation.	
9	To study the heat transfer coefficient in a vertical and a horizontal condenser.	
	To find out the emissivity of a surface.	

Intended Outcomes:

- To understand the thermal conductivity of liquid and solid at laboratory scale.

- To calculate heat transfer coefficient in shell and tube, double pipe heat exchanger.
- To able to calculate emissivity of surface.

DCH-4083: CHEMICAL REACTION ENGINEERING LAB.

Introduction: To study about working of various types of equipments/instruments related to chemical reaction engineering.

Objective: To give the hand-in-hand experience of lab-scale experiments on rate constant in various types chemical reactors based on the theoretical understanding and its application learned in theory course.

Credits: 2 **Semester IV** **L-T-P: 0-0-4**

List of Practical

Module No.	Contents	Teaching Hours
1	Find out kinetic constant and study conversion of a given reaction in a batch reactor.	36
2	Find out kinetic constant and study conversion of a given reaction in a plug flow reactor.	
3	Find out kinetic constant and study conversion of a given reaction in a CSTR.	
4	Study and operation of an adiabatic batch reactor.	
5	Study of a reversible reaction in a batch reactor.	
6	To determine energy of activation of reaction of ethyl acetate with sodium hydroxide.	
7	Find out specific rate constant and activation energy of a reaction in a plug flow reactor.	
8	To determine reaction equilibrium constant of reaction of acetic acid with ethanol.	
9	To determine changes in free energy, enthalpy and entropy for the reaction of potassium iodide with iodine.	
10	Study and operation of a cascade CSTR.	

Intended Outcomes:

- To understand the kinetic and rate of conversion in different type reactors as per given reaction at laboratory scale.
- Understand about the working and principles of various types of reactors.

ANNEXURE – D

Course Curriculum

Session – 2022- 2025

Three Year Diploma Course

In

Chemical Engineering

Third Year

GLA UNIVERSITY POLYTECHNIC

COURSE STRUCTURE, CONTACT HOURS and CREDITS

DISCIPLINE : CHEMICAL ENGINEERING
SEMESTER : V (FULL-TIME)

Sr. No.	Subject Code	Subject Name	Periods Per Week			Cr
			L	T	P/D	
1	DCH-5001	Chemical Technology	4	0	0	4
2	DCH-5004	Instrumentation & Control Utilities	4	0	0	4
3	DCH-5006	Automatic Process Control	4	0	0	4
4	DCH-5007	Industrial Pollution Abatement	4	0	0	4
5	DCH-5086	Basics of Computer Application Lab	0	0	2	1
6	DCH-5083	Chemical Technology lab.	0	0	2	1
7	DCH-5084	Industrial Training Seminar	0	0	2	1
8	DCH-5090	Soft Skill and PDP lab	0	0	4	2
9	DCH-5085	Energy Lab	0	0	2	1
TOTAL			**16**	**0**	**12**	**22**

L- Lecture Period, **T**-Tutorial Period, **P**- Practical Period, **D**- Drawing Practice Period, **Cr**. - Credits,

DCH–5001: Chemical Technology

Introduction: To study about manufacturing of various chemicals and other useful products through chemical process at large scale like fertilizer, cement, industrial gasses, sugar, pulp and paper etc.

Objective: To provide the basic knowledge of production of various products by using various unit operation and unit process in economical way. It also provides the information about major engineering problems in any production unit.

Credits: 04 **Semester V** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
Module –I	**Industrial gases**: Manufacture and uses of oxygen, hydrogen, nitrogen, carbon dioxide. **Fertilizer industries**: Ammonia, Nitric Acid, Ammonium Sulphate, Urea, Ammonium Nitrate, Phosphorus, Phosphoric Acid, **Calcium Phosphates**,**Super Phosphates, Triple Super Phosphate**, Nitro Phosphate, N-P-K Fertilizer. **Chlor-alkali industries:Common Salt, Caustic Soda, Chlorine**, Hydrochloric Acid**, Soda-Ash,** and Bleaching Powder. **Sulphur industries:** Manufacture of sulphuric acid, oleum. **Cement industries:** Manufacture of Portland cement. **Insecticides, pesticides & herbicides**: definition, types of insecticides, pesticides and hertricides, uses and quantity and variety, benefits.	21
Module – II	**PROCESS INDUSTRIES:** A. **Sugar industry**: manufacture of cane sugar. B**. Pulp and paper industry:** sulfite & ground wood pulp for paper manufacture of paper, especially paper. **Soap & detergents industry**: Manufacturing of soap, glycerin as by products from soap manufacturing Detergents, Detergents raw material and manufacturing of detergents. House disinfects (Phenyl). **Fermentation industry**: Introduction, Types of fermentation processes, Production of ethyl alcohol by fermentation, Industrial alcohol, manufacture of industrial alcohol-, Beers, Wines & Liquors. **Polymer industry** : Types of polymer, Polymerization Process,	21

	Manufacture of Polyethylene, Styrene Nylon 6, Nylon 66	

REFERENCE BOOKS

1. Outline of Chemicals Technology by M. Gopala Rao.
2. Chemical Process Industry by Shreve and Austin
3. Chemical Technology Vol I & II by G. N. Pandey
4. Industrial chemicals by Faith, Keyes and Clark
5. Industrial Chemistry by Dr. B. K. Sharma

Intended Outcomes:

- Understand about raw materials, properties, chemical reaction, operation condition and all processing steps used in manufacturing of any product in detail.
- To able to produce any chemicals or products at small scale and industrial scale with the knowledge of this subject.
- To capable to handle the various units of any industry.

DCH 5104: Instrumentation & Control Utilities

Introduction: To study about basic concept of instrumentation, principles and operation of measuring instruments which are used in design and configuration of automated system.

Objective: To provide the basic knowledge of various types measuring instruments used in chemical process industries. He has also knowledge of PLC and DCS control based system used in process industries (Refineries, Fertilizers, Paper, Power plant, Food processing, chemical etc).

Credits: 4 **Semester V** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
Module 1	**Introduction to Instrumentation:** Concept and importance of instrumentation, classification of instruments, basic elements of instruments, characteristics of instruments in detail, brief explanation of first order system and second order system. **Temperature Measuring Devices:** Definition of thermometer, temperature scale, mercury in glass thermometer, Bimetallic & pressure spring thermometers, Principle of thermo electricity, Sebeck effect, Peltier effect & Thomson effect, Industrial thermocouple, lead wire thermo wells, Resistance thermometer, Single Wheatstone bridge circuit & Null bridge resistance thermometer, Deflection resistance thermometer circuit, Radiation & Optical pyrometers. **Measurement of Pressure & Vacuum:** Pressure, Vacuum & Head measuring elements for gauge pressure & Vacuum, indicating elements for pressure gauges, Brief explanation about measurement of absolute pressure, Measuring pressures in corrosive fluids, Static accuracy of pressure gauges, Response of Mechanical Pressure gauges.	21
Module 2	**Measurement of Head & Level** : Head, density & Sp. Gravity, Direct measurement of liquid level, Pressure (Level) measurements in open vessel, level measurement in pressure vessels, Measurement of Interface level, Density measurement, level measurement by weighing, level of dry materials **Process Recording Instruments** Recording Instruments, Indicating & Signaling Instruments, and Transmission of instrument readings, Control center, and Instrumentation diagram. **Distributed Control Systems** Principle of working, important control modes with simple diagram, Comparison of PLC & DCS system, Principle of modem	21

Textbooks:

1. Industrial instrumentation - Donald P Eckman
2. Instrumentation - K. Johnson

3. Industrial Instrumentation & Control - S. K. Singh

Intended Outcomes:

- Understand working of various measuring devices like thermocouple, pressure gauge etc.
- Understand the working of PLC and DCS system.
- Understand the control of various equipments used in chemical process industries.

DCH-5006: Automatic Process Control

Introduction: To study about the basic of control system, elements of control system, open and closed loop control system used in process controller design. of heat exchanger and evaporators etc. its uses in industrial control systems to achieve a production level of consistency, economy and safety which could not be achieved purely by human manual control.

Objective: To provide the basic knowledge of automatic process control system used in industries such as oil refining, pulp and paper manufacturing, chemical processing and power generates plants. The main objective of this subjects to aware the students about various process variables and their control techniques.

Credits: 4 **Semester V** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
Module 1	**Introduction**: What is Automatic control, Advantage of Automatic control, manual and automatic control, physical and block diagram. **Elements Of Control System:** Definition-Input means, controlling means, actuating means, measuring means, final control elements. **Process Characteristics**: Process variables, process degree of freedom, forcing function, step fn., ramp, impulse, sinusoidal function, Laplace transformation. Elements of process dynamics: - Proportional, Capacitance. Time constant and oscillatory element, determination of system function or transfer function of the following:- (Sketch physical diagram and block diagram) (a) 1st order system or time constant element:- (i) Naked bulb thermometer. (ii) Stirred tank heater. (iii) Mixing process. (iv) R.C. Circuit. (v) Liquid levels. (vi) Two time constant type liquid vessel cascaded i.e. Non -interacting and non cascaded, i.e. interacting (vii) Continuous stirred tank chemical reactor with 1st order chemical reaction. (b) 2nd order system or oscillatory type element. (i) Bulb in thermo well. (ii) Mechanical damper. Response of 1st order system to step, ramp, impulse and sinusoidal inputs, Response of I2nd order system to step Change (Transient response).	21

Module 2	**Controller Characteristic Or Modes Of Control Action:** Elements of controller, proportional control, Integralcontrol, proportional-integral control, proportionalderivative control, proportional-integral-derivativecontrol, Two positions control. **Closed Loop In Automatic Control:** Standard block diagram symbol, overall transfer fn. for asingle loop system, overall transfer function for change in set point and for change in load, overall transfer function. Multiloop control system, unit step response of the following. (i) Proportional control at stirred tank heater for set point Change and for load change. (ii) P.I control of stirred tank heater for set point change and Load change. **Programmable Logic Controller (PLC):** Introduction, Principle of operation, Architecture ofprogrammable controller, Programming \the programmable controller, Application of programmable control. **Distributed Control System (DCS)**: Real time computer control system - concept, functional requirements of distributed process control system, configuration some popular DCS.	21

Textbooks:

1. Process System Analysis and Control by Coughnowr and Koppel
2. Chemical Process Control by George Stephanopalous
3. Computer Control of Industrial Process by S. Savas, Emenule
4. Industrial Instrumentation by D. P. Eckman

Intended Outcomes:

- Can able to understand the basic concept of control system and their functioning, use of first order system in various types of equipments
- Can able to understand the concept in closed loop control-based P & PI control.
- Can able to understand the Programmable Logic Controller (PLC) and Distributed Control System (DCS)

DCH-5007: Industrial Pollution Abatement

Introduction:

A diploma holder must have knowledge of different types of pollution caused due to industries andconstructional activities so that he may help in balancing the ecosystem and controlling pollution byvarious control measures. He should also be aware of environmental laws related to the control ofpollution. He should know how to manage the waste.

Objective: To provide the basic knowledge of various types industrial pollution and measuring instruments used in chemical process industries. He has also knowledge of Pollution control based inprocess industries (Refineries, Fertilizers, Paper, Power plant, Food processing, chemical etc).

Credits:04 **Semester V** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
Module 1	**Introduction**: Basics of ecology, eco system- concept, and sustainable development, ResourcesRenewable and non renewable. **Air Pollution** **Source of air pollution:**Effect of air pollution on human health, economy, plant,animals. Air pollution control methods. Air Pollution control equipment in industries. a) Settling chamber b) Cyclone c) Scrubber (dry & wet) d) Multicyclone e) Electrostatic precipitator f) Bag Filter **Water Pollution:** Impurities in water Cause of water pollution, Source of water pollution. Effect ofWater pollution on human health, Concept of dissolved O2, BOD, COD. Prevention of water pollution- Water treatment processes, Methods of treatment of industrial waste water like a) Chemical treatment b) Physio-Chemical treatment c) Bio-chemical treatment	21
	Soil Pollution Sources of soil pollution Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical,Animal and human, excreta, sediments and E-waste Effect	

Module 2	of Solid wasteDisposal of Solid Waste- Solid Waste Management **Noise pollution** Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level,Different method of minimize noise pollution. **Environmental Legislation** Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air(Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, RoleAnd Function of State Pollution Control Board and National Green Tribunal (NGT),Environmental Impact Assessment (EIA). **Impact of Energy Usage on Environment** Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material.	21

Text Books:

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.

Intended Outcomes:

After undergoing the subject, the student will be able to:

- Comprehend the importance of ecosystem and sustainable
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abatement of pollution.
- Explain environmental legislation acts.
- Define energy management, energy conservation and energy efficiency
- Demonstrate positive attitude towards judicious use of energy and environmental Protection
- Identify the role of non-conventional energy resources in environmental protection.

DCH-5082: Chemical Technology Lab

Introduction: To study about the preparation of soaps, detergents, paints adhesives, resins and phenyls.

Objective: To provide the information about preparation ofsoaps, detergents, paints adhesives, resins and phenyl at laboratory scale. This helps to increase the capability to work in large scale chemical industries.

Credits: 01 **Semester V** **L-T-P: 0-0-2**

List of Practical

EXPERIMENT No.	Contents	Teaching Hours
1.	Preparation of Phenyl (domestic disinfectant).	24
2.	Preparation of Soap.	
3.	Preparation of liquid detergent.	
4.	Preparation of Powder detergent.	
5.	Preparation of Thermo Plastics.	
6.	Preparation of Polymer – Bakelite	
7	Prepaation of Oil based Paints	

Intended Outcomes:

- Can able to understand the chemical and apparatus required for the preparation of various types domestic as well as industrial products at laboratory scale.
- Can able to handle the production unit of small scale and large scale industry independently.
- Can able to set up a small scale industry.

DCH-5085: Energy Lab

Credits: 1 **Semester-V** **L-T-P: 0-0-2**

List of Practical

EXPERIMENT No.	Contents	Teaching Hours
1.	To Study of Solar Panel system.	
2.	To Determine the Flash Point of any fuel.	
3.	To Determine the Fire Point of any fuel.	
4.	To determine the Viscosity of fuel.	
5.	To study the Wind energy mill.	24
6.	To determine the Calorific Value of given Solid Fuel	
7.	To determine the Calorific Value of given Liquid Fuel	
8.	To determine the Moisture Content in a given coal sample.	
9.	To determine the smoke point of liquid fuels	

Intended Outcomes:

- Can able to understand the chemical and apparatus required for the preparation of various types domestic as well as industrial products at laboratory scale.
- Can able to handle the production unit of small scale and large scale industry independently.

- Can able to set up a small scale industry.

DCH-5084: Industrial Training Seminar

Credits: 1 **Semester-V** **L-T-P: 0-0-2**

Evaluation of professional industrial training report and viva-voce/presentation aims at assessing students' understanding of materials, industrial processes, practices in the industry/field and their ability to engagein activities related to problem-solving in industrial setting as well asunderstanding of application of learnt knowledge and skills in real lifesituation. The formative and summative evaluation may comprise of Weightages to performance in testing, general behaviour, quality of reportand presentation during viva-voce.

DCH-5086: Basics of Computer Application Lab

Credits: 2 **Semester-V** **L-T-P: 0-0-4**

Since this subject is practice oriented, the teacher should demonstrate the capabilities of computers to students while doing practical exercises. The students should be made familiar with computerparts, peripherals, and connections and proficient in making use of MS Office/Open Office/Libreoffice/Google Suit in addition to working on internet. The student should be made capable of working on computers independently in the field of chemical engineering Process and equipments.

ANNEXURE – E

GLA UNIVERSITY POLYTECHNIC

COURSE STRUCTURE, CONTACT HOURS and CREDITS

DISCIPLINE : CHEMICAL ENGINEERING
SEMESTER : VI (FULL-TIME)

Sr. No.	Subject Code	Subject Name	Periods Per Week			Cr
			L	T	P/D	
1	DCH-6001	Process Equipment Design	4	0	0	4
2	DCH-6002	Industrial Management & Entrepreneurship Development	4	0	0	4
3	DCH-6003	Conventional and Non-ConventionalEnergy resources	4	0	0	4
4	DCH-6004	Petroleum Refining Technology	4	0	0	4
5	DCH-6081	Process Equipment Design Lab	0	0	4	2
6	DCH-6083	Design Project	0	0	4	2
7	DCH-6090	Soft Skill and PDP Lab	0	0	4	2
		TOTAL	**16**	**0**	**12**	**22**

L- Lecture Period, **T**-Tutorial Period, **P**- Practical Period, **D**- Drawing Practice Period, **Cr**. - Credits,

DCH-6001: Process Equipment Design

Introduction: To study about the basic engineering materials, design of pressure and non pressure vessel, design of heat exchanger and evaporators etc.

Objective: To provide the basic knowledge of process design and mechanical design of various processing equipment used in chemical process industries.

Credits: 04 **Semester VI** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
Module 1	**Basic engineering materials**: Ferrous materials, non ferrous materials, synthetic materials, natural materials. **Basic considerations in process equipment design**: Introduction, general design procedures, fabrication techniques, and equipment classification, power for rotational **Design considerations**: Introduction, materials selections, corrosion prevention, and stresses created due to static & dynamic loads, elastic instability, combined stresses and theories of failure, fatigue, brittle, fracture, creep, temperature effect, radiation effects, effects of fabrication methods, economic consideration. **Power requirement of pumps**: Problems relating calculations of horse power (H.P.), N.P.S.H., for flow of incompressible fluid. **Pressure vessels**: Selection of type of vessels and storage tank, criteria of selection, fixed head and floating head type storage tanks, causes of failure of vessels, methods of fabrication, types of formed heads, stress in Thin shells subjected to internal pressure,	12
Module 2	**Distillation column**: Preparation of equilibrium diagram, problems relating calculation of theoretical plates at a given reflux ratio and total reflux, minimum reflux ratio, feed plate location, by McCabe-Thiele methods for separation of ideal binary mixtures, derivation of q-line equation. **Heat exchanger and condensers**: Problems relating calculation of L.M.T.D., individual and overall heat-transfer coefficients, number of tubes, number of passes, heat-transfer coefficient for condensing vapors by Wilson's plot. **Evaporators:** Problems relating calculation of heating area, steam requirement, steam economy for single and double effect evaporators. Methods of feeding evaporators and effect of boiling	12

	point rise (B.P.R) and hydrostatic head.	

Intended Outcomes:

- Can able to design of heads, closures, support, nozzles and flanges of process equipment used in chemical process industries.
- Can able to process design of heat transfer equipments like double pipe and shall and tube heat exchangers, evaporators etc.
- Able to design pressure vessels (cylindrical and spherical shape) like distillation column, absorption column etc.

DCH-6002: Industrial Management and Entrepreneurship Development

Introduction: To study the basic concept of management, essential elements of management and techniques or managerial skills to handle the any industry at top management level.

Objective: The student will able to know principles of management,, management of material, finance, sales and marketing and also knowledge about Labour Legislation Act.

Credits: 04 **Semester VI** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	**Principles of Management** 1.1 Management, Different Functions: Planning, Organizing, Leading, Controlling. 1.2 Organizational Structure, Types, Functions of different departments. 1.3 Motivation: Factors, characteristics, methods of improving motivation, incentives, pay, promotion, rewards, job satisfaction, job enrichment. 1.4 Need for leadership, Functions of a leader, Factors for accomplishing effective leadership, Manager as a leader, promoting team work. **Human Resource Development** 2.1 Introduction, objectives and functions of human resource development (HRD) department. 2.2 Recruitment, methods of selection, training strategies and career Development. 2.3 Responsibilities of human resource management – policies and functions, selection – Mode of selection – Procedure – training of Workers, Job evaluation and Merit rating. **Wages and Incentives** 3.1 Definition and factors affecting wages, methods of wage payment. 3.2 Wage incentive – type of incentive, difference in wage, incentive and bonus; incentives of supervisor. 3.3 Job evaluation and merit rating. **Human and Industrial Relations** 4.1 Industrial relations and disputes. 4.2 Relations with subordinates, peers and superiors. 4.3 Characteristics of group behaviour and trade unionism. 4.4 Mob psychology. 4.5 Grievance, Handling of grievances. 4.6 Agitations, strikes, Lockouts, Picketing and Gherao. 4.7 Labour welfare schemes. 4.8 Workers' participation in management. **Professional Ethics** 5.1 Concept of professional ethics. 5.2 Need for code of professional ethics. 5.3 Professional bodies and their role	21
	Sales and Marketing management	

II	6.1 Functions and duties of sales department. 6.2 Sales forecasting, sales promotion, advertisement and after sale services. 6.3 Concept of marketing. 6.4 Problems of marketing. 6.5 Pricing policy, break even analysis. 6.6 Distribution channels and methods of marketing. **Labour Legislation Act (as amended on date)** 7.1 Factory Act 1948. 7.2 Workmen's Compensation Act 1923. 7.3 Apprentices Act 1961. 7.4 PF Act, ESI Act. 7.5 Industrial Dispute Act 1947. 7.6 Employers State Insurance Act 1948. 7.7 Payment of Wages Act, 1936. 7.8 Intellectual Property Rights Act **Material Management** 8.1 Inventory control models. 8.2 ABC Analysis, Safety stock, Economic ordering quantity. 8.3 Stores equipment, Stores records, purchasing procedures, Bin card, Cardex. 8.4 Material handling techniques. **Financial Management** 9.1 Importance of ledger and cash book. 9.2 Profit and loss Account, Balance sheet. 9.3 Interpretation of Statements, Project financing, Project appraisal, return on investments. **Entrepreneurship Development** 10.1 Concept of entrepreneur and need of entrepreneurship in the context of prevailing employment conditions. 10.2 Distinction between an entrepreneur and a manager. 10.3 Project identification and selection. 10.4 Project formulation. 10.5 Project appraisal. 10.6 Facilities and incentives to an entrepreneur. **Fundamental of Economics** 11.1 Micro economics. 11.2 Macro economics. **Accidents and Safety** 12.1 Classification of accidents based on nature of injuries, event and place. 12.2 Causes and effects of accidents. 12.3 Accident-prone workers. 12.4 Action to be taken in case of accidents with machines, electric shock, fires and erection and construction accidents. 12.5 Safety consciousness and publicity. 12.6 Safety procedures. 12.7 Safety measures – Do's and Don'ts and god housing keeping.	21

Intended Outcomes:

- To handle the situation in some accidental and critical phases of industrial management.
- To understand the management skills about handling of finance, workers, materials, human ethics etc.
- To able to tackle the situation of any accidents and hazards during functioning of plant.

DCH – 6003: Conventional and Non Conventional Source of Energy

Introduction: To develop, operate and maintain alternative energy sources systems. It is therefore essential to know basics of energy conversion, conservation, and energy audit and waste heat recovery techniques.

Objectives: Develop awareness for effective utilization of alternative energy sources and Identify different components of solar energy and wind energy devices, biomass plant and apply principles of energy conservation and energy management techniques

Credits: 04 **Semester VI** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	**PART-A : CONVENTIONAL ENERGY SOURCE** **Introduction**: Introduction of various Solid, Liquid and Gaseous fuels. **Solid fuels**: Wood, Charcoal, Coal (Peat, Lignite, Bituminous and Anthracite) and Coke. Calorific value Definition and experimental determination by bomb calorimeter and calculations. Washing of coal, Purpose of washing, Principle description and operation of Jigs and washers, Carbonization (Low temperature and High temperature). **Liquid fuels**:(i) Fuel Oil, Gasoline, Diesel Fuels, Kerosene, Biogas, Biomass, GNG, PNG. (ii) Properties (Sp. gravity, Viscosity, Flash & fire Point,(iii Advantages and disadvantages of liquid fuels. **Gaseous fuels**: Natural Gas, LPG -Advantages and disadvantages of gaseous fuels. **Combustion calculation:** Calculation of percentage of products of combustion, numerical Questions.	21
II	**NON CONVENTIONAL ENERGY SOURCE:** **Solar energy:** Energy from the Sun, Application of solar technology: Solar thermal, Electricity production, Fuel production, Energy storage methods. **Wind energy**: Source of wind energy, Wind power: Types of wind power, Wind power industry: Wind forms, wind turbine. **Bio energy**: Resource of Bio energy, Solid biogas, Electricity generation from biomass, Bio energy product. **Hydro energy**: Types of Hydropower, Advantage and disadvantages of hydro energy.	21

	Geothermal energy: Types of Geothermal energy, Resources, Production, Renewability and sustainability. **Wave and tidal energy:** Generation of Tidal energy and wave energy. Generating methods, Difference between wave and tidal energy.	

Text Books:

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “ Energy Resources: Conventional & Non-Conventional “ BSP Publications,2006.
4. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.

Ref. Books:

1. D.S. Chauhan,”Non-conventional Energy Resources” New Age International.
2. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.

Intended Outcomes:

- Understand working of various power plants.
- Understand constructional features and working of devices used in non-conventional energy sources.
- Understand economical and operational aspects of power plants.
- Calculate the efficiency of power generation cycl

DCH-6004: Petroleum Refining Technology

Credits: 04 **Semester VI** **L-T-P: 4-0-0**

Module No.	Contents
I	**Introduction** Petroleum industry is one among core chemical industries and it has large employment potential. Inthis subject, the students will be imparted detailed knowledge of petroleum refining and petroleumproducts along with major petrochemicals. **Petroleum Exploration** Theories of formation of crude oil, chemistry and composition of crude oil.Petroleum Industry in India.Test methods of petroleum products-flash and fire point, octane number, cetane number, aniline Point, viscosity index, cloud point and pour point, density and specific gravity, ASYM distillation. Petroleum Products Composition, properties, specification and uses of LPG, Naphtha, Motor spirit (Gasoline), Kerosene, Aviation turbine fuel, Diesel fuel, Fuel oil, lubricating oils (Automotive engine oils, industrial Lubricating oils), petroleum wax, bitumen. **Crude Oil Distillation** Impurities in crude oils, desalting of crude oils, atmospheric distillation of crude oil, vacuum Distillation of atmospheric residue.Thermal Conversion Process-Thermal cracking visbreaking (Conventional visbreaking and soakervisbreaking), Coking (fluid coking, Flexi coking) **Catalytic Conversion Process** Fluid catalytic cracking, catalytic reforming, hydro cracking, catalytic alkylation, catalytic Isomerization, Finishing process- Hydrogen sulphide removal process, sweetening processes (caustic treatment,doctor treating process), merox process, solvent extraction process (Edeleanu process)Introduction to major petrochemicals like Synthesis gas, Acetaldehyde, Ethylene oxide, styrene, Butadiene.

LIST OF RECOMMENDED BOOKS

1. Petroleum Refining Technology by Ram Prasad; Khanna Publishers, Delhi
2. Petroleum Refining Engineering by W.L. Nelson; McGraw-Hill
3. Modern Petroleum Refining Processes by B. K. Rao; Oxford and IBH PublishingCo.
4. Petrochemical Process Technology by I. D. Mall; McMillan India

5. Introduction to petrochemicals by S. Maiti; Oxford and IBH Publishing Co.

Intended Outcomes:

After completion of this course, the students will be able to:

- Get familiar with different petroleum refining processes.
- Test petroleum products

DCH-6081: Process Equipment Design LAB

Introduction: To study about the calculation and design ofPressure Vessel, Storage Tanks, Heat Exchanger (Shell & Tube), Evaporator and Distillation Column.

Objective: To provide the basic knowledge about the calculation and design ofvarious partsused inPressure Vessel, Storage Tanks, Heat Exchanger (Shell & Tube) and Distillation Column in details.

Credits: 02 **Semester VI** **L-T-P: 0-0-4**

List of Practical

EXPERIMENT No.	Contents	Teaching Hours
1.	**Design of Pressure Vessel**: Shell, Head or Cover, Nozzle, Flanged Joint, Support.	
2.	**Design of Storage Tanks**: Material, Bottom Design, Shell Design, Wind graders for open - Top Tanks, Roof - Curb Angles, Self - Supporting Roof Design, Column Supported Roofs, Nozzles and Mountings.	
3.	**Design of Heat Exchanger (Shell & Tube):** Shell Design**,** Shell CoverTubes**,** Tube Sheet**,** Tie Rods and Spacers**,** Baffles**,** Channel**,** Channel Cover.	36
4.	**Design of Distillation Column:** Shell Thickness**,** Stresses in Column Shell**,** Column Internal Details**,** HeadSupport **,**Tray	
5.	**Design of Evaporator**: Shell design, Shell cover, Tubes, Steam Economy & Heating are, Vacuum creating device, Impingement Baffles	

Intended Outcomes:

- Can able to understand about the calculation and design ofvarious partsused inPressure Vessel, Storage Tanks, Heat Exchanger (Shell & Tube) and Distillation Column in details.
- Can able to design of heads, closures, support, nozzles and flanges of process equipment used in chemical process industries.

DCH-6083: Design Project

Credits: 02 **Semester VI** **L-T-P: 0-0-4**

The purpose of evaluation of project work is to assess student's ability to apply, in an integrated manner, learnt knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The formative and summative evaluation may comprise of weightage to nature of project, quality of product, quality of report and quality of presentation followed by viva-voce.

DCH-5090: Soft Skill and PDP Lab

Credits: 02 **Semester VI** **L-T-P: 0-0-4**

By the end of the **soft skills training program**, the students should be able to:

Develop effective communication skills (spoken and written).

Develop effective presentation skills.

And in **Personality Development Program** the students should be able to:

- Increase their productivity by appropriately managing priorities
- Better their leadership skills by developing their self-skills
- Develop their coaching capabilities by enhanced communication
- Develop an optimistic attitude and become a problem solver
- Manage their day effectively by learning the time management skills
- Become a team-player with better collaboration with others
- Learn to set SMART goals and objectives to produce results
- Effectively deal with interruptions and distractions of life and work
- Improve productivity framing a strong mental attitude in stressful situation