Syllabus of Final Year

B. Tech. (Chemical Engineering)

Faculty of Science and Technology

University Institute of Chemical Technology
North Maharashtra University, Jalgaon

(Academic Year 2017 – 18)

Revised Syllabus
B. Tech. (Chemical Engineering)
w. e. f. 2017-18

Course Code	Title of Course	Teaching Hours	Tutorial	Credits	Practical Hours	Credits	Total Credits
Seventh Sem.							
CHC-401	Modeling, Simulation and CAD	04	-	04	04	02	6.0
CHL-402	Transport Phenomena	04	-	04	-	-	4.0
CHC-403	Process Dynamics & Control	04	-	04	04	02	6.0
CHL-404	Plant Design, Economics & Costing	04	-	04	-	-	4.0
ELECTIVE	Elective-IV	04	-	04	-	-	4.0
Total		20	-	20	08	04	24
Eighth Sem.							
CHP-407	Industrial Training/Project	-	-	-	32	16	16
CHP-408	Technical Seminar & Colloquium	-	-	-	08	04	04
Total		-	-	-	40	20	20

Nomenclature of the courses:

First two letters of the course code denote the branch/ division. Thus, CH stands for Chemical Engineering Course. Similarly, ES stands for Engineering Sciences and HM for Humanities and Management Sciences.
Third letter denotes the type of the course, viz lecture, practical or lecture + practical. If third letter is L, the said course is of lectures. Practical course is shown by P and C represents the course consisting of lecture + practical. First numeral of the course code denotes the level of course, and the other two are for number of course in particular branch/division.
For example, course BSL-101 – mathematics-1. Here BS stands for basic science branch, L for lecture; For 101, first 1 for first year and 01 for first course of basic science.
Examination System:
For each theory paper of 04 and 03 credits, Major Examination with paper of 60 marks and duration of 03 Hours will be conducted.
For each theory paper of 02 credits, Major Examination with paper of 30 marks and duration of 02 Hours will be conducted.

For each practical Lab. of 01, 1.5 and 02 credits, the examination will be conducted for 03 hours' duration for CH, ES and BS practical. For all these practical's, the Major examination carries 60 marks. For practical lab with 01 credit, the examination will be conducted as viva-voce (major- 30, minor - 20)

List of Electives (Elective IV)

CHL-410 Newer Separation Techniques

CHL-411 Fundamentals of Computational Fluid Dynamics

CHL-412 Advanced Pharmaceutics

Fourth Year Revised Syllabus of B. Tech (Chemical Engineering) w.e.f 2017-18
Seventh Semester

Department : Department of Chemical Engineering

Course Code : CHC- 401

Course Title : Modeling, Simulation and Computer Aided Design

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

1. To understand physical systems in Chemical Engineering and to develop their mathematical models by considering total continuity equation, component continuity equation, momentum balance and energy balance equation. To obtain solution of these models by solving various mathematical equations using computer languages and software tools.
2. To understand concept of Computer Aided Design

Course Content:

Unit-I
Introduction to process modeling and simulation, Roll of process Dynamics and control, historical background, motivation and laws and languages of process control. Application of mathematical modeling, fundament laws, servo and regulatory system, open and closed loop system. **(10 Hrs)**

Unit-II
Continuity equations, energy equations, equation of motion, Transport equations, equation of state phase and chemical equilibrium and kinetics.
Problems related to this. **(10 Hrs)**

Unit-III
Mathematical models of chemical engineering systems such as- CSTR'S with all variations, Two heated tanks, Vaporizers, multicomponent flash drum, Batch reactors, Reactor with mass transfer, ideal binary distillation columns, Batch, Multicomponent non ideal distillation column, Batch distillation with hold up, pH systems. Problems related to these all mentioned above. **(10 Hrs)**

Unit-IV
Computer Aided Designs:-
Computer application in flow sheet calculations of design approach in- heat exchangers (Double pipe, shell and tube), Vessels, separators (Vertical and Horizontal) Cyclone,
(10 Hrs)

Unit-V

Computer aided design of Distillation column, use of smoker equation, Design of multicomponent distillation column **(10 Hrs)**

Course Outcome:

1. Understand the mathematical models, model building concept, fundamental of process control.
2. Develop model equations for the given system in terms of material balance, energy balance, component balance and momentum balance.
3. Develop computer Aided Design of unit operations like Heat Exchanger, Cyclone, Separation tanks, Distillation etc.

Reference Book:

1. Control for chemical engineers (second edition) by luben W.C.,1996
2. Modeling and Process Modeling Simulation and simulation in chemical engineering by Franks, RogerG.E.Willey Publication.,1972
3. Computer Aided Design by Koker**.**1980
4. Process Modeling and Simulation Central Techno Publication R.W.Gaikwad and Dr Dhiran First Edition 2003

Department : Department of Chemical Engineering

Course Code : CHC- 401

Course Title : Modeling, Simulation and CAD Practical

Course Type : Practical

Total Hrs/Week : 03

Course Credit : 1.5

Course Objective:

Application of C programming language for solving model equations. Awareness and understanding about softwares like UNISIM, Polymath for solving mathematical models.

Course Content:

Digital simulation and modeling of chemical engineering systems such as CSTR's , FBR's, Batch reactors , PFR, distillation column etc. with the help of FORTRAN , MATLAB OR POLYMATH SOFTWARE.

Computer aided design in the field of absorbers, heat exchangers, chemical reactors. (Using FORTRAN/ C)

Course Outcome:

Ability to solve mathematical models using various tools.

Department : Department of Chemical Engineering

Course Code : CHL-402

Course Title : Transport Phenomena

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

To introduce the fundamentals in heat, mass & momentum transfer to solve real life problems involving transports of momentum, energy and mass in biological, mechanical and chemical systems using a unified approach.

Course Content:

Unit-I

Viscosity and mechanism of momentum transfer, Velocity distribution in laminar flow. Velocity distribution with more than one independent variable. Equation of continuity, rectangular, cylindrical & spherical co-ordinate. Reaction for momentum energy and kinetic energy factor (A&B) for different velocity profiles.

(10 Hrs)

Unit -II

Navier stokes equation for cylindrical co-ordinates ®, direction:- r, θ,ϕ direction final expression only for numerical, stream function (ψi) & (ψo) and their velocity distribution Ur & Uϕ pressure distribution r, θ,ϕ direction.

(10 Hrs)

Unit -III

Mass & Heat transfer boundary layer for laminar and turbulent flow. Expression for Sherwood number and Nusselt number for different velocity profile using Van Kormal E momentum integral equation. Relation between Hydrodynamic boundary layer & concentration boundary layer & thermal boundary layer.

(10 Hrs)

Unit -IV

Mass & Heat Transfer fully developed flow:

a) 1) Constant mass flux & laminar velocity profile (circular tube)
b) Heat Transfer :-
    1) Constant Heat flux but flat velocity profile.
    2) Constant heat flux laminar velocity profile
    3) Constant Heat Flux, Flat velocity profile & Parabolic temp. Distribution.

c) Boundary layer flow derivation in terms of power of (2, 3, 4) and trigonometric & numerical based on it. **(10 Hrs)**

Unit V

Diffusion Operation:-

1) Methods for determination of diffusivity,
2) Diffusion operation: solid- liquid-gas.

Molecular Diffusion Analogies:-

1) Momentum Transfer
2) Mass Transfer
3) Heat Transfer

(10 Hrs)

Course Outcome:

1. To understand the transport processes in chemical engineering.
2. To enhance the ability of students to understand & analyze the real life complexities in heat, mass and momentum transfer.
3. To enhance the ability of students to understand & analyze the industrial problems along with appropriate boundary conditions.
4. To enhance the ability of student to develop the steady and time dependent solutions along with their limitations when they actually entered in their professional life.
5. To get the students well acquainted with application of transport processes to the problems in chemical engineering.

Reference Book:

1. C.O.Bennett &J.O.Mayer Mc Graw Hills, 1982 Momentum, mass & heat Transfer
2. Stewart Bird, Transport Phenomena, Second Edition
3. Fluid Mechanics by R.K.Bansal , Laxmi Publication, First Edition 2005

Department : Department of Chemical Engineering

Course Code : CHC- 403

Course Title : Process Dynamics and Control

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

The utilization of chemical process control and dynamics in automatic, advanced chemical process and study of response of various forcing functions for first, second and higher order control system and study of various types of control mechanism for optimize control of chemical process and their stability

Course Content :

Unit-I

Laplace transform, inversion by partial fractions, Dynamic Behavior of First Order Control System. Study of forcing functions Step, ramp,impulse, sinusoidal etc. Transfer functions of Continuous Stirred Tank Reactor, mercury thermometer, mixing process, liquid level single tank system and various problems based on it, response of first order control systems, step response, ramp or linear response, impulse response, sinusoidal response equation with numerical. **(10 Hrs)**

Unit-II

Interacting and Non-Interacting Control Systems. Step response for non-interacting, interacting control system, Transportation lag, the dynamic behavior of second order control systems. Transfer function for Manometer, Damped vibrator, Step and Impulse response equations for under damped, critically damped, over damped second order system. Numericals based on under damped, critically damped, over damped second order system. **(10 Hrs)**

Unit-III

Characteristics of an Under damped second order control systems for step function. Decay ratio,overshoot,rise time, response time and numerical,Mechanism of Control System and Block Diagram Representation.Control aspects, block diagram, negative verses positive feedback control systems, servo and regulator control problems. Block diagram development for continuous stirred tank heater,Block diagram reduction techniques and problems. Mechanism of controllers and control valve.

(10 Hrs)

Unit-IV

Mechanism of proportional, proportional derivative, proportional integral and PID controller. Function of different modes of control. Application of the controllers. Stability Analysis of Control System. Stability for linear system, Routh Test for stability. Rouths Theorem, Root locus diagram: procedure for plotting root locus diagram for negative feedback systems. Problems based on stability of control system and Root locus diagrams.

(10 Hrs)

Unit-V

Frequency response analysis of linear systems, procedure for plotting the Bode diagram,Numerical based on Bode stability criteria, concept of phase and gain margins, phase crossover and gain crossover frequencies. Design of feedback control systems using frequency response techniques. Nyquists plots. Ziegler. Nichols optimum controller settings.

(10 Hrs)

Course Outcome:

1. From the course the students will able to know the complete dynamics of the chemical process and understand the different kinds of forcing function and responses.
2. The student will understand the method for obtaining the transfer function, response equation and physical behavior of first, second and higher order control system.
3. Students understand various types of control actions like ON OFF, P, PI, PD, PID and their applications and usefulness in the different chemical process and Industries.

4. Students able to know about some analytical and graphical methods like root locus, frequency response analysis, controller tunings for getting stability of chemical process control system.

Reference Book:

1. Coughanowr, Donald R., Process Systems Analysis and Control, McGraw Hill.Third Edition,2009
2. Stephanopoulos George, Chemical Process Control Prentice Hall Inc.First Edition
3. Harriott Peter, Chemical Process Control, Tata McGraw Hill.T.M.H.Edition1972
4. Process Control and Instrumentation R.P.VyasCetral Techno Publication First Edition 2001
5. Process Dynamic and Control,S.S.Bhagade and G,D,Nageswar First Edition 2011

Department : Department of Chemical Engineering

Course Code : CHC- 403

Course Title : Process Dynamics and ControlLab.

Course Type : Practical

Total Hrs/Week : 04

Course Credit : 02

Course Objective:

To carry outan experiment of Process Dynamics and Control, the students come to know how the equations developed from physical system, their response studies and application to Industries.

Dynamic study of first order system, Study of response of Mercury thermometer, Step response study of first order system. Determination of time constant of Mercury thermometer, thermocouple, bimetallic thermometer etc.

To study the dynamics of second order system. Impulse response study of U tube manometer, Determination of damping coefficient and time constant of second order system.

Study of pneumatic control valve and Valve characteristics. Calibration of instruments such as, thermocouples RTD sensors, Study of two tank liquid level non-Interacting systems, Study of Mixing tank and determine time constant, Study of two tank liquid level Interacting systems. At least any seven experiment to be conducted.

Course Outcome:

1. The students are capable to know about the basic theory of various physical systems and to know the actual responses for different inputs for first, second and Interacting non interacting control system.

2. Students able to determine mathematically and graphically time constant, transfer function and response equation by carried out an experiment.
3. Students come to know how the system behaves with different disturbances and how it can be optimized for stable control system.
4. The order of the physical system like first, second and interacting non interacting control system is determined experimentally.

Department : Department of Chemical Engineering

Course Code : CHL- 404

Course Title : Plant Design Economics & Costing

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

The objective of the course is to provide students with a firm grasp of the essential principles of Management, Project identification project feasibility and Project Scheduling Technique with Suitable Examples. This course will help student to understand the concepts and terminology that are used in Management economics and costing. Students know about pipeline design on the basis of fluid dynamics and mechanical properties. students also understand the balance sheet, store ledger account by various methods and solve various engineering problems in process optimization.

Course Content:

Unit -I

1. Project identification, project feasibility
2. Project testing based on vibality risk & Cost estimation.

3 . Evaluation of project by different methods on the basis of Vibality i) Net Present Value method. ii) Method of Rate of Return on Initial Investment iii) Pay out Period iv) Method of Discount Cash Flow v) Capitalized cost method vi) Internal rate of return method vii) Break Even Chart

4 Evaluation of project by different methods on the basis of Risk i) Profitability Index ii) Demand fore casting iii) Standard Deviation Approach

5 Evaluation of project by different methods on the basis of Cost i) Preparation of Cost sheet and statements ii) Preparation of Profit Loss Statement

(10 Hrs)

Unit -II

1) New developments in management, CPM & PERT
Principle and Objectve of CPM and PERT
Net work Diagram for calculation Time Duration

2. Linear Programming Problem (Numerical based on each method)

i) General simplex method ii) Primary & Dual technique method

iii)Direct simplex method Iv) Graphical Method **(10 Hrs)**

Unit -III

1. Cost analysis, fixed capital, working capital, Preparation of store ledger account by pricing issue methods. LIFO, FIFO, Simple average, weighted average
2. Depreciation, significance of inadequacy and obsolescence, and depreciation methods (Numerical Based on It)

(10 Hrs)

Unit -IV

1.Layout and location, objective, principle
2 layout and Location factors.
3. Equipment layout diagram (ELD)
4. Tank firm cum utility block diagram for different processes. (TFCUBD)

(10 Hrs)

Unit -V

1. Design of process flow sheet from process information. Plant utility line diagram for including valve, IPC symbol, unit operations symbols (mass & heat transfer)
2. Utility Block diagram for Boiler House, Refrigeration Plant,Compressor House and Electricity
3. Piping design: Fluid dynamic parameter (Q, Delta, D), piping insulation, Pipe Welding, pipe Fittings, types of valves, selection of valve, P.C. and instrumentation Symbols. Numerical Based On it
4. Design of pipeline on the basis of fitting, valve, Insulation, IPC & utility panel board.

(10 Hrs)

Course Outcome:

1. To enhance knowledge of students about pipeline design on the basis of fluid dynamics and mechanical.
2. To understand the various methods of profitability evaluation and their application.
3. To enhance knowledge of students to understand the balance sheet and store ledger account by various methods.
4. To enhance knowledge of students about various scale up methods and to understand the new development in management and optimization techniques.
5. To enhance the ability of students to identify and solve various engineering problems in process optimization.

Reference Books:

1. Process equipment Design by S.D. Dawande.Denett and Co Fifth Edition
2. Industrial Organization &Management B.V. Pathak & M.S. Mahajan, Nirali Prakashan First Edition 1986
3. Plant Design & Economics for Chemical Engineering by M.S. Peters & K.D.Timmerhaus. Fifth Edition
4. Shreves Chemical Process Industry George J, Fifth Edition 2017
5. Out lines of Chemical Process Technology by Drydens, Third Edition, 1997
6. Applied Mathematics Optimization -IV by G.V.Kumbhojkar First Edition 2002
7. Process Design of Equipment by S.D. Dawande.Central Techno Publication Fourth Edition 2005
8. Plant Utilities by D.B.Dhone Nirali Prakashan, First Edition 2008.

9. Introduction to Accountancy by T,S,Grewal and S.C.Gupta,S.Chand Publication First Edition 2008
10. Managerial and Cost Accounting by Christopher J,S. and L.M.Weather, Ventus Publisher APS, 2011

Department : Department of Chemical Engineering

Course Code : CHL- 410

Course Title : Newer Separation Techniques(Elective-IV)

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

The student should understand the various Newer Separation Techniques and cop up with recent advancements in technology in these field. They should understand techniques such as adsorption, chromatography, membrane separation,ion exchange methods and advanced separation method in distillation. The student should compare between the conventional and non-conventional separation methods. The student should know the merits and how to overcome the difficulties while applying these new techniques commercially. The student should understand about environmental issues and should provide solutions for green and clean technologies.

Course Content:

Unit –I

Need for newer separation techniques, characterization of separation process. Adsorption-different types of adsorbents, comparison with conventional methods. Adsorption isotherms. **(10hrs)**

Unit –II

Elusion Chromatography, retention theory, Chromatography methods for separation such as gas-liquid, liquid-liquid, HPLC, principle, methods and equipments for chromatographic separations. Comparison with other separation methods. **(10hrs)**

Unit –III

Membrane separation methods such as reverse osmosis, pervaporation, microfiltration, ultra-filtration, electro dialysis etc. industrial application of membranes, membrane materials their characteristics. **(10hrs)**

Unit –IV

Ion Exchange: Ion exchange resins, resin capacity, Equilibrium, Exchange Kinetics, Ion exchange equipments. Industrial application of ion exchange membranes. **(10hrs)**

Unit –V

Advanced separation methods in Distillation: Azeotropic and extractive distillation, Short Path distillation, Steam distillation, Reactive distillation. **(10hrs)**

Course Outcome:

1. Students are aware about Newer Separation Techniques and cop up with recent advances in separation Techniques.
2. They can compare between the traditional mass transfer separation techniques and these alternative and newly developed Techniques.
3. Students are able to understand the theoretical principles and practical consideration for adsorption, chromatography, membrane separation, ion exchange methods and advanced separation methods in distillation.
4. The students are able to understand how these techniques are cost effective in terms of energy savings and environmental friendly which provides solution for green and clean technologies.

Reference Books :

1. Mass Transfer Operation by Robbert E. Treybal Mc Graw Hills , 1981
2. Chemical Engineering Vol – II by Richardson'sand Coulson Sixth Edition 1999.
3. Distillation by S.L.Pandharepande First Edition
4. Mass Transfer- II by K.A.Ghavane ,NiraliPrakashan, Seventh Edition 2009

Department : Department of Chemical Engineering

Course Code : CHL- 411

Course Title : Fundamentals of Computational Fluid Dynamics (Elective-IV)

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

To provide the in depth knowledge of computational fluid mechanics along with basic principles in the subject like properties of fluids, pressure measurement, hydrostatics, kinematics of flow especially dynamics of flow, types of flows, dimensional analysis, boundary layer & handling of fluids in order to enhance the knowledge from industrial point of view.

Course Content:

Unit-I

Conservation equations for mass, momentum and energy; Comparison of various numerical techniques for CFD; Review of finite difference and finite element methods; Solution to discretizedalgebric equation; Theory of Partial Differential Equations - classification; canonical forms; linear vs nonlinear problems; characteristics; well-posed problems.

(10Hrs)

Unit -II

Vector & tensor analysis in fluid dynamics, Rheology of complex fluids, Flow of complex fluids, effect of temperature-pressure and process conditions on the properties of complex.

Fluids Methods for Unsteady Problems, Solution of the Navier-Stokes Equations.

(10Hrs)

Unit -III

Burgers equation and nonlinear steepening; filtering; the shallow water equations; grid staggering, nonlinear instability, conservation constraints. Boundary Conditions (BC) for Hyperbolic Problems/Systems - Options of BC, wave-permeable radiation conditions, well-posedness of BC; PE & vorticity/streamfunction formulations.

(10Hrs)

Unit -IV

Finite-volume method for diffusion problems; Finite-volume method for convection and diffusion problems – pressure velocity coupling; Construction of geometry and discreation using Gambit-Fluent's manuals. **(10Hrs)**

Unit -V

Commercial CFD solvers; Turbulance modeling; Implementation of boundary conditions; Introduction to multiphase flow; Customizing commercial CFD solver; Unsteady state simulations. **(10Hrs)**

Course Outcome:

1. To enhance the knowledge about fluid properties, behavior of fluid under different conditions, hydrostatics & pressure measurement by various means.
2. The students should get well acquainted with basic principles in kinematics & dynamics of fluid flow with its application.
3. To clear the basic concepts of students about various types of flows, complexities in flow through pipeline systems with detail study of laminar, turbulent flow.
4. The students should get well acquainted with phenomena of boundary layer formation and separation. Also to understand the dimensional analysis and its application to solve the complex problems in heat & momentum transfer.
5. The get the students well acquainted with handling of fluids, to get them introduce with various pumps, compressors, blowers and power requirement in it and to enhance the ability of students to identify and solve various engineering problems.

References Book:

1. Anderson, J.D., "Computational Fluid Dynamics: The Basics with Application" McGraw-Hill Co. Inc.First Edition 1995
2. Anderson, D.A., Tannehill, J.C. and Pletcher, R.H., "Computational Fluid Mechanics and Heat Tranasfer", Hemisphere Publishing Corporation.Third Edition 2012
3. Patankar, S.V., "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation.Third Edition
4. Ferziger, J.H. and Peric, M., "Computational Methods for Fluid Dynamics", Springer.Third Edition 2002
5. Versteeg, H.K. and Malalasekera, W., " An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Prentice-Hall Inc.Longman Scientific and Technical Publication, First Edition 1995

Department : Department of Chemical Engineering

Course Code : CHL- 412

Course Title : Advanced Pharmaceutics(Elective-IV)

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective

To understand about different kinetic models
To acquaint about solubility and distribution phenomenon
To know about different solid and semi solid dosage forms
To understand about different liquid dosage forms and aerosols

Course content:

Unit -I

Diffusion and Dissolution: Diffusion: Introduction, Definition, related phenomenon like Dialysis, osmosis, ultrafiltration; Applications of diffusion, terms used in diffusion. Ficks first law of diffusion, Ficks second law of diffusion. Diffusion cells: Simple diffusion cell – Apparatus & measurement of diffusion. Brief explanation of Horizontal & vertical type cells. Dissolution: Introduction, Definition, Applications of dissolution, Noyes and Whitney equation. Dissolution studies apparatus {Rotating basket & Paddle type only}. Powder dissolution- Hixson – Crowell cube root law.

(10Hrs)

Unit -II

Solubility and Distribution Phenomenon: General principles, types of solvent, solubility of gases in liquids, effect of temperature, pressure, chemical reaction and salting out of gases, solubility of liquids in liquids, solubility of salts: solubility of slightly soluble electrolyte, solubility of weak electrolyte- influence of pH, influence of solvent, combine influence of pH and solvents, , influence of surfactants: Distribution coefficient{Nernst coefficient}, True and Apparent Distribution Phase rule – 1 component system{water}; co-solvency.

(10Hrs)

Unit -III

Solid Dosage Forms & Semisolid Dosage Forms

a. **Powders and granules**: Manufacturing of powders and granules. Problems during manufacturing.
b. **Tablets**: Formulation development: types of tablets, properties of drugs such as compressibility, flowability, dose, stability, site of drug release & absorption, additives & factors affecting their selection. Advance granulation techniques like extrusion-spheronization, pelletization, spherical crystallization, fluid bed granulation. Problems during manufacturing of tablets.
c. **Coating of Tablets**: - Types of coating, Material used & processed employed for each, coating equipments including different types of coating pans, fluidized bed coating, Defects in coating.
d. **Hard Gelatin & Soft Gelatin Capsules**: Introduction, shell excipients, Mfg. of shells, properties of raw materials, environmental controls, evaluation, filling equipments for hard Soft gelatin capsules.

e. **Semisolid Dosage Forms**: Emulsion, Gel & Ointment Preparations, Ointments: bases, formulation factors. Manufacturing processes, equipments & packaging.

(10Hrs)

Unit -IV

Liquid Dosage Form:

a) Solutions: Factors affecting rate of solution, Formulation, Manufacturing process and equipments, Packaging (Glass and plastic containers)
b) Disperse Systems: Introduction, theories of emulsifications and suspensions-DLVO Theory, vehicles, stabilizers, preservatives wetting agents, emulsifying agents, colors and flavors. HLB values and its determination. Manufacturing and packaging. Problems in manufacturing of disperse systems. **(10Hrs)**

Unit -V

Aerosols: Introduction, Definition, Advantages, Disadvantages, Applications, Classification. Brief explanation of Propellants & their classes, Application of liquefaction to aerosols i.e. principle of aerosols, mechanism of working of aerosols, Two & Three Phase systems.

(10Hrs)

Course Outcome:

Upon successful completion of this course the student will be able to:

1. Understand the different laws and kinetic models
2. Understand about solubility and distribution phenomenon
3. Understand about different solid and semi solid dosage forms
4. Understand about different liquid dosage forms and aerosols

Reference Book:

1. Theory and Practice of Industrial Pharmacy:Leon Lachman 1986
2. Martin's Physical Pharmacy and Pharmaceutical Sciences: Patrick J. Sinko, Yashveer Singh First Edition
3. Handbook of Pharmaceutical Manufacturing Formulations, Second Edition: Sarfaraz K. Niazi
4. Remington, The Science and Practice of Pharmacy Twenty First Edition
5. Modern Pharmaceutics: Gilbert S. Banker, Christopher T. Rhodes CRC Press, 2002
6. Theory and Practice of Industrial Pharmacy: Herbert A. Led and Febiger Joseph L. 1986

Eighth Semester

Department : Department of Chemical Engineering

Course Code : CHP- 407

Course Title : Industrial Training/ Project

Course Type : Project

Total Hrs/Week : 32

Course Credit : 16

Course Objective:

To nurture the interest of graduates in research with subject knowledge they have acquired earlier. To get exposure for recent industrial practices and technological revolutions.
To get exposure for data compilation and report writing of their research work.

Course Content:
Training/Project
Research Project at Department: The entire semester will be devoted for the detail experimental work on a research problem from the field of Chemical Engineering selected by the student and specially approved by the faculty member/s designated as research guide/s. The student will present his/her findings in the form of neatly typed and bound thesis and will have to appear before panel of experts for defending his/her Thesis. **Or**

Research Project/ Training at Industry: The student will undertake research work/ Training at selected reputed Institute / Industries for six months on a topic allotted by the concerned institute / Industry Management and approved by the Department. His/her progress will be jointly reviewed by the Department and the concerned Institute / Industry Management. The student will present his/her findings in the form of neatly typed and bound thesis, which will carry approval and attendance certificate issued by the concerned Industry Management and will have to appear before panel of experts for defending his/her Thesis. **Or**
Student can opt the theory and /or practical courses of his / her branch of interest for 16 credits.

Course Outcome:
On completion of Industrial Training, the Technocrat will develop skills and good practices related to

1. Increase awareness in the field of Chemical Engineering and Technology
2. Identification of raw materials, material selection, performance criteria, applicable processing method, product defects, their practical causes and remedies.
3. Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
4. Career opportunities and Choices.

Department : Department of Chemical Engineering

Course Code : CHP- 408

Course Title : Technical Seminar & Colloquium
Course Type : Seminar

Total Hrs/Week : 08

Course Credit : 04

Course Objective:
The students will develop necessary skills in understanding current trends in the field of Chemical Engineering andTechnology. Graduates will get an in-depth exposure of literature survey, preparing technical review report. It will also lead to improvement of technical presentation skills of the graduates. It will be immensely helpful in upliftment of young

technocrats from institute to industry. The students get moulded in such a fashion that they can easily adopt to the industrial environment. It also helps the budding engineers in inculcation of corporate ethics & culture as a part of their behaviour.

Course Content :

1 **C**ritical review of selected topics in Chemical Engineering and allied subjects
2 Standard typed report under the supervision of Guide.
3 Oral presentation of the report before panel of experts

Course Outcome:

1. Knowledge of recent and emerging trends in the field of Chemical Engineering and Technology.
2. Ability to identify and solve technical problems.
3. Development of soft skills requiredto enhance presentation abilities.
4. Recognition of the need for, and an ability to engage in life-long learning.

Student will be required to prepare a critical review of selected topics in Chemical Engineering and allied subjects and submit the same in the form of a standard typed report under the supervision of Guide. The student will also be required to make an oral presentation of the report before panel of experts.