SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)

(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (Effective from Session 2021-22)

B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

SECOND YEAR, THIRD SEMESTER (AICTE-NEW)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
						Sessional			
	THEORY		L	T	P	IA	ESE	TOTAL	
01.	CH203TBS05	Biology	3	0	0	30	70	100	3
02.	CH203TBS06	Mathematics-III	3	1	0	30	70	100	4
03.	CH203TPC01	Material and Energy Balance Calculations	3	1	0	30	70	100	4
04.	CH203TPC02	Fluid Mechanics	3	1	0	30	70	100	4
05.	CH203TPC03	Thermodynamics-I	3	0	0	30	70	100	3
	PRACTICAL								
01.	CH203PPC01	Chemical Engineering Lab-I	0	0	3	30	20	50	1.5
02.	CH203PPC02	Fluid Mechanics Lab	0	0	3	30	20	50	1.5
		Total	15	3	6			600	21

IA – Internal Assessment

ESE - End Semester Examination

Total Credits : 21

Total Marks – 600

Total Periods / week - 24

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (Effective from Session 2021-22)
B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING
SECOND YEAR, FOURTH SEMESTER (AICTE-NEW)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
	THEORY					Sessional			
			L	T	P	IA	ESE	TOTAL	
01.	CH204THS02	Business Communication and Presentation Skill	3	0	0	30	70	100	3
02.	CH204TBS07	Numerical Methods in Chemical Engineering	3	1	0	30	70	100	4
03.	CH204TPC04	Thermodynamics-II	3	0	0	30	70	100	3
04.	CH204TPC05	Particle and Fluid Particle Processing	3	1	0	30	70	100	4
05.	CH204TPC06	Process Instrumentation	3	1	0	30	70	100	4
	PRACTICAL								
01.	CH204PBS03	Numerical Methods in Chemical Engineering lab	0	0	2	30	20	50	1
02.	CH204PPC03	Particle and Fluid Particle Processing lab	0	0	3	30	20	50	1.5
03.	CH204PPC04	Process Instrumentation Lab	0	0	3	30	20	50	1.5
		Total	15	3	8			650	22

IA – Internal Assessment

ESE - End Semester Examination

Total Credits : 22

Total Marks – 650

Total Periods / week - 26

Program Outcomes	
PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering comm Modules and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Program Specific Outcomes	
PSO1	The students of the programme will have a strong foundation in mathematics, basic sciences and chemical engineering to meet the current demands in professional world with cutting-edge research in chemical and allied engineering disciplines.
PSO2	Graduates would be equipped with a working knowledge in professional courses such as process economics, project engineering, industrial safety and sustainable development to work in the conventional as well as frontier area of Chemical Engineering which enables them suitable for chemical industries.
PSO3	Graduates of chemical engineering will be able to communicate in a professional setting, including soft skills, technical writing, presentation, and management skills making them employable to industries.

CH203TBS05 **Biology** **[L:3, T:0, P:0]**

Objectives

Students will be introduced to the basics of biology such as cell structure and functions, inheritance & evolution, basic concepts of genetics, and an introduction to microbiology

Contents:

Unit I : Basics: Diversity of life, prokaryotes and eukaryotes, basic cell constituents and macromolecules.

Unit II : Biochemistry: Metabolism (Catabolism and Anabolism) and Bioenergetics.

Unit III : Genetics: Basic principles of Mendel, molecular genetics, structure and function of genes and chromosomes, Transcription and Translation, gene expression and regulation.

Unit IV : Cell Biology: Macromolecules, membranes, organelles, cytoskeleton, signalling, cell division, differentiation, and motility.

Unit V : Microbiology: host-microbe interactions, physiology, ecology, diversity, and virology.

Text Book

1. Gardner, Simmons & Snustad "Principles of Genetics" Student Edition, Wiley publication, 2006.

2. P.K. Gupta, "Principles of Genetics", Rastogi Publication, 2018-19.

3. Prescott's, "Microbiology"Joanne Willey Publication.

4. David L. Nelson and Michael M. Cox, "PRINCIPLES OF BIOCHEMISTRY", W.H.

Freeman & Company, 2008

5. Gerald Karp, Janet Iwasa, Wallace Marshall, "Karp′s Cell Biology" Global Edition,

2018

Course Outcomes

1. Students will get insight into biology as a science, outlining the diversity, organization.
2. Student will understand the fundamental principles of living systems.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2										2		
CO2	1	1	2										2		
1-Weak, 2- Moderate, 3-Strong															

CH203TBS06 Mathematics-III [L:3, T:1,P:0]

Course Objective: Basic concepts of statistics, curve fittings, correlation coefficient, probability, distribution and sampling methods.

Unit I : Introduction to statistics, mathematical statistics, variable, frequency distribution, exclusive and inclusive class intervals, type of series, graphical representation: histogram, frequency polygon, ogive measure of central tendency various types of averages, Mean median mode for grouped and ungrouped data, geometric mean, harmonic mean, measure of dispersion Skegness and Kurtosis.

Unit II : Curve fittings by method of least square- straight line parabola correlation-scatter cliagrem's Karl Pearson's coefficient of correlation. Limits for correlation coefficient, rank correction. Regression linear regression, equation to the line of regression. Regression coefficient, angle between two lines of regression.

Unit III : Theory of probability-Mathematical and statistical definition of probability sample space. Finite sample space sample point, events theorem of total probability. Sample and compound event. Conditional probability, theorem of compound probability, Baye's theorem, use of binomial theorem.

Unit IV : Theoretical distribution- Binominal distribution mean, standard deviation and Pearson's β and γ coefficient. Poisson distribution, mean, variance normal distribution.

Unit V : Random and simple sampling-mean, and standard deviation in simple sampling of attribute, test of significant for large sample test of significance based on Chi square, T, F and Z distribution degree of freedom, condition for applying.

Text Books:

1. M. Ray, H. S> Sharma & C. C. Chaudhary, "Mathematical Statistics", Ram Prasad Publications.
2. P. C. Biswal, "Probability & Statistics", PHI.
3. A.A.AFTI, "Statistics analysis"

Course Outcome:

1. Students should be able to solve statistics Problems, problem based on correlation, regression and curve fittings, probability problems, problems relating to mean, standard deviation.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1							2		
1-Weak, 2- Moderate, 3-Strong															

CH203TPC01 **Material and Energy Balance Calculations** **[L:3, T:1, P:0]**

Objectives

The course will serve as a basis for all further chemical engineering courses that are part of the curriculum.

Unit I : Introductory concepts of units, physical quantities in chemical engineering, Dimensionless groups, "basis" of calculations, Gases, Vapours and Liquids: Equations of state, Vapour pressure, Clausius Clapeyron equation, Cox chart, Duhring's plot, Raoult's law.
Unit II : Humidity and Saturation, humid heat, humid volume, dew point, humidity chart and its use.
Unit III : Material Balance: Introduction, solving material balance problems without chemical reactions, material balances with recycle, bypass and purge, material Balance with chemical reaction, Concept of stoichiometry and mole balances, examples, including combustion.
Unit IV : Energy balance: open and closed system, heat capacity, calculation of enthalpy changes.
Unit V : Energy balances with chemical reaction: Heat of reaction, Heat of combustion.

Suggested Text Books

1. S. N. Saha, "Chemical Process Engineering Calculation", Dhanpat Rai Publication Co. (Pvt.) Ltd., New Delhi
2. Bhatt, B. I., Vora, S. M., "Stoichiometry", Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2004.

Suggested References Books

1. Felder, R. M.; Rousseau, R. W., "Elementary Principles of Chemical Processes", Third Edition, John Wiley & Sons, 2000
2. Hougen, O. A., Watson, K. M., Ragatz, R. A., "Chemical Process Principles, Part I Material & Energy Balances", Second Edition, CBS Publishers& Distributors, 2004
3. Himmelblau, D. M., Riggs, J. B. "Basic Principles and Calculations in Chemical Engineering", Eighth Ed., Pearson India Education Services, 2015.
4. Venkataramani, V., Anantharaman, N., Begum, K. M. Meera Sheriffa, "Process Calculations", Second Edit ion, Prentice Hall of India.
5. Sikdar, D. C., "Chemical Process Calculations", Prentice Hall of India.

Course Outcomes

Students completing the course will

1. Develop mastery over process calculations relevant to Chemical Engineering Processes.
2. Be able to handle elementary flow-sheeting, material and energy balance calculations.
3. Be able to solve problems based on without and with chemical reactions, and involving concepts like recycle, bypass and purge.
4. Be familiar with equations of state and properties of gases and liquids, including phase transition.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2									3	2	
CO2	2	3	2	3									3	2	
CO3	3	3	2	3									3	2	
CO4	2	2	2	2									3	2	
1-Weak, 2- Moderate, 3-Strong															

CH203TPC02 **Fluid Mechanics** **[L:3. T:1. P:O]**

Objectives:

The objective of this course is to introduce the mechanics of fluids (fluid statics and fluid dynamics), relevant to Chemical Engineering operations. The course will impart the knowledge of basic concepts of kinematics of flow, different forces on fluids. Now visualization, flow measurement, flow transportation and types of flow.

Unit I : Fluid Static & Applications: Hydrostatic equilibrium, hydrostatic equilibrium in centrifugal field and its applications in chemical engineering like manometers decanters.

Fluid Flow Process: velocity gradient and shear, types of fluids, concept of viscosity, kinematic viscosity, nature of flow- laminar, turbulent, Reynolds number, boundary layer formation and separation

Unit II: Basic Equations for Fluid Flow: Mass balance & momentum balance equations.

Bernoulli's equation without and with corrections for solid boundaries, kinctic energy, friction factor, pump work.

Unit III: Incompressible Fluids Flow through pipes, flow characteristics- shear stress. friction factor, laminar flow for newtonian fluids, Hagen Poiscuille equation, laminar flow for non-newtonian liquids, turbulent flow through pipes and close channels and its characteristic equations, friction factor and its dependence on roughness, Reynolds number, friction factor for flow through channels of non-circular cross section - concept of equivalent diameter. frictional losses due to sudden change in velocity or direction of flow: expansion, contraction. effect of fittings, flow of liquids in thin layers.

Unit IV: Transportation of Fluids: pipe fitting like bends, elbows, flanges, tee and different types of valves, seals for moving parts, pumps. NPSH, power requirement, types of pumps - centrifugal & positive displacement, trouble shooting in operation - priming & cavitation, characteristic curves - head / capacity / power / efficiency, capacity- head flow and head work relationship. metering of fluids: variable head meters- venturi meter & orifice meter, variable area meter - rotameter, insertion meters - pitot tube.

Unit V: Differential analysis: mass and momentum balances. Navier-Stokes equation, unidirectional flow. viscous flow. Stokes law, skin drag and pressure drag. potential flow. potential function, solution of Laplace equation.

Suggested Text Books :

1. M. White. Fluid Mechanics. Tata-McGraw Hill.
2. V. Gupta & S. K. Gupta, Fundamentals of Fluid Mechanics, New Age International.
3. W. L. McCabe, J. C. Smith & P. Harriot. Unit Operations of Chemical Engineering.
MeGraw-Hill International Edition
4. O. Wilkes. Fluid Mechanics for Chemical Engineers, Prentice Hall of India.
5. R. W. Fox. P. J. Pritchard & A. T. MeDonald, Introduction to Fluid Mechanics, Wiley-Indial
6. R. Welty, C. E. Wicks. R. E. Wilson, G. Rorrer, Fundamentals of Momentum. Heat and Mass Transfer. Wiley.

Suggested References Books :

1. B. R. Munson, D. F. Young, T. H. Okiishi & W. W. Huebsch, Wiley-India.
2. R. L. Panton, Incompressible Flow, Wiley-India.
3. R. B. Bird, W. E. Stewart & E. N. Light foot, Transport Phenomena, Wiley India.

Outcomes :

1. Velocity profiles by simplification of equations of motion in simple 1-D flows
2. Boundary layer thicknesses, friction factor. pressure drop, power requirements in single phase flow in pipes.

3. Two phase gas/liquid pressure drop.
4. Power requirements, NPSH requirements of pumps.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1									2	1	3
CO2	3	3	1	2									2	1	3
CO3	3	3	2	2									2	1	3
CO4	3	3	2	2			1						2	1	3
1-Weak, 2- Moderate, 3-Strong															

CH203TPC03 **Thermodynamics-I** **[L:3. T:O. P:0]**

Objectives:

Principles and application of first and second law of thermodynamics, and phase equilibria.

UNIT 1: Basic Concepts. Definitions & P-V-T Relations: Approaches of thermodynamics, system & its types, types of processes, work. heat, energy. P-V-T relations of fluids: graphical representation of P-V-T behavior, mathematical representation of P-V-T behavior (Ideal gas law, van der Waals. Beattie-Bridgeman, Benedict-Webb-Rubin, Redlich-Kwong, Virial equation of state), generalized compressibility factor correlation, equations of state (Redlich-Kwong, Soave-Redlich-Kwong, Peng-Robinson, Lee-Kesler, Virial coefficient correlation)

UNIT II: First Law of Thermodynamics: First law, calculation of internal energy, enthalpy, heat capacities, application of first law for open and closed systems, Throttling process, Joule-Thompson effect.

UNIT III : Second law of thermodynamics, heat engine, heat pump, refrigerator, Kelvin and Clausious statement, criteria of irreversibility, Carnot theorem, Carnot cycle, Clausious inequality, entropy and its principles, third law of thermodynamics : definition and applications.

UNIT IV : Thermochemistry: Enthalpy, heat of reaction at constant pressure and volume, Hess's law of constant heat summation, effect of temperature on heat of reaction at constant pressure (Kirchoff's equation), heat of dilution, heat of hydrogenation, heat of formation, heat of neutralization and heat of combustion, adiabatic flame temperature.

UNIT V : Equation of' state, VLE/LLE equilibrium: Le Chatlier's principle, kinetic theory, vapour-liquid equilibrium in ideal solution, liquid-liquid equilibrium diagrams, equation state of real gas, principles of corresponding states

Suggested Text Books

1. J. M. Smith, H. C. Van Ness & M. M. Abbott, Introduction to Chemical Engineering Thermodynamics, McGraw-Hill International Edition.
2. Y. V. C. Rao. Chemical Engineering Thermodynamics. University Press.
3. K. V. Narayanan, A Textbook of Chemical Engineering Thermodynamics, Prentice Hall of India

Suggested References Books:

1. R.C. Srivastava. Thermodynamics a core course, PHI publication, India.

Course outcomes:

Students would be able to :

1. Apply mass and energy balances to closed and open systems.
2. Evaluate the properties of non-ideal gases.
3. Solve problems involving liquefaction, refrigeration and different power cycles.
4. Evaluate the enthalpy of reactions of chemical processes.
5. Analvse the system of VLE and LLE.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	--	--	--	--	--	--	3	3	3	--
CO2	3	3	3	1	3	--	--	--	--	--	--	3	3	3	--
CO3	3	3	3	1	3	--	--	--	--	--	--	3	3	3	--
CO4	3	3	3	1	3	--	--	--	--	--	--	3	3	3	--
CO5	3	3	3	1	3	--	--	--	--	--	--	3	3	3	--
1-Weak, 2- Moderate, 3-Strong															

CH203PPC01 **Chemical Engineering Lab-1** **[L: 0: T:0; P:31**

Objectives:

The course covers the hands on experience of basic principle of viscosity, adsorption, solid handling, gravity settling. drag coefficient, etc.

Content:

1. Determine the viscosity of Given Sample using Ostwald Viscometer
2. Determine the adsorption coefficient of coal and sawdust samples
3. Determine the Bulk density and angle of repose at different moisture of given sample.
4. To determine the bed void fraction of given sample
5. Determine the relative humidity sing wet and dry buib temperature.
6. Determine the percentage of heavy and light particle of given sample.
7. Determine the drag coefficient of given sample.
8. Prepare the soap using start.

- Any other experiments may be added further, if needed.

Outcomes:

At the end of the laboratory course students will be able

1. To understand the factors affecting to flow in industrial point of view.
2. To understand how the conveyer belt shifting the materials from off place to another place in industry.
3. To understand how gravity settling, adsorption are implemented in industry

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	1	3	--	--	--	--	--	--	3	2	--	--
CO2	3	3	3	1	3	--	--	--	--	--	--	3	2	--	--
CO3	3	3	3	1	3	--	--	--	--	--	--	3	2	--	--
1-Weak, 2- Moderate, 3-Strong															

CH203PPC02 **Fluid Mechanics Lab** **[L:0, T:0, P:3]**

Objective:

The objective of this course is to give the students the practical exposure of the theory and concepts of the subject fluid mechanics. The course will provide the knowledge of different flow meters and pressure measurement through the experiments. It will also help in understanding the theoretical concepts through experiments.

List of experiments:

1. To determine the coefficient of discharge of the given Venturimeter.
2. To determine the coefficient of discharge of the Orificemeter connected in between a pipe line.
3. To determine the coefficient of discharge of the Rotameter.
4. To determine the velocity of the flowing fluid and coefficient of the given pitot tube.
5. Study and verification of the Bernoulli's theorem.
6. Experimental determination of hydraulic coefficients.
7. To measure the pressure using manometer.
8. To determine the type of flow and Reynold's number through Reynold's experiment.

Any other experiments may be added further, if needed.

Outcome:

1. The students will be able to visualise the concepts.
2. The students will understand about different components of the flow system.
3. The students will be able to operate different meters.
4. The students will be able to measure and calculate different flow parameters.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**1**									**2**	**1**	
CO2	**3**	**2**	**1**	**1**									**2**	**1**	
CO3	**3**	**1**	**3**	**1**					**1**				**2**	**1**	
CO4	**3**	**3**	**1**	**1**					**1**				**2**	**1**	
1-Weak, 2- Moderate, 3-Strong															

EN204THS02 Business Communication and Presentation Skill [L:3, T:0, P:0]

Objectives

To develop the communication skills like writing technical letters, reports and presentation skills.

Contents:

Unit I: Business communication covering, Role of communication in information age; concept and meaning of communication; skills necessary for technical communication; Communications in a technical organization; Barriers to the process of communication.

Unit II: Style and organization in technical communication covering, Listening, speaking, reading and writing as skills; Objectivity, clarity, precision as defining features of technical communication; Various types of business writing: Letters, reports, notes, memos; Language and format of various types of business letters; Language and style of reports; Report writing strategies; Analysis of a sample report

Unit III: Communication and personality development covering, Psychological aspects of communication, cognition as a part of communication; Emotional Intelligence; Politeness and Etiquette in communication; Cultural factors that influence communication; Mannerisms to be avoided in communication; Language and persuasion; Language and conflict resolution.

Unit IV: Language Laboratory emphasizing Listening and comprehension skills; Reading Skills; Sound Structure of English and intonation patterns;

Unit V: Oral Presentation and professional speaking covering, Basics of English pronunciation; Elements of effective presentation; Body Language and use of voice during presentation; Connecting with the audience during presentation; projecting a positive image while speaking; Planning and preparing a model presentation; organizing the presentation to suit the audience and context; Basics of public speaking; Preparing for a speech.

Suggested Text books:

1. Fred Luthans, Organizational Behaviour,McGraw Hill
2. Lesikar and petit, Report writing for Business
3. M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill
4. Wallace and masters, Personal Development for Life and Work, Thomson Learning

Suggested Reference books:

1. T. M. Farhathullah, Communication skills for Technical Students
2. Michael Muckian, John Woods, The Business letters Handbook
3. Herta A. Murphy, Effective Business Communication
4. MLA Handbook for Writers of Research Papers

Course Outcomes

Students should be able to

1. Communicate properly, Write technical letters and reports.
2. Present reports and seminars in an attractive way.
3. Understand ethics, etiquette, and business communication.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	1	3	1	1			3
CO2								3	1	3	1	1			3
CO3								3	1	3	1	1			3
1-Weak, 2- Moderate, 3-Strong															

MA204TBS07 Numerical Methods in Chemical Engineering [L:3, T:0,P:0]

Course Objective: The objective of this subject is to introduce students to numerical methods used to solve engineering problems, in particular chemical engineering problems, using numerical methods and computer programming.

UNIT – I Introduction of Errors and their Analysis, types of errors, numerical problems on error analysis, curve fitting: method of least squares, fittings of straight line and parabola and by method of moments.

UNIT – II Numerical Solution of Algebraic and Transcendental Equations: Secant Method, Regula-falsi Method, Newton Raphson Method, Solution of a system of simultaneous linear algebraic Equations Direct method: Gauss elimination Method, Iterative methods, Gauss Seidel Iterative method.

UNIT – III The Calculus of Finite Differences: Finite differences, Difference formula, operators and relation between operators. Inverse Operator, Interpolation with equal intervals: - Newton's forward and backward interpolation formula. Interpolation with Unequal intervals: - Lagrange's interpolation.

UNIT –IV Numerical Differentiation and Integration: Numerical Differentiation Newton's forward and Backward difference interpolation formula. Numerical Integration: Trapezoidol rule, simpson is (1/3)rd and (3/8)th rule, Boole's rule, Weddle rule.

UNIT – V Numerical solution of ordinary differential equation: Taylor series method, Euler's method, Modified Euler method Runge's method Runge Kutta method.

Books Recommended:

1. Jain & Iyngar Numerical Methods for Scientific and Engineering Computations.
2. G. S. Rao, Numerical Anlysis.
3. B S Grewal, Numerical Methods in Engineering and Science.
4. H. K. Das, Advance Engineering Methods.
5. V. Rajaraman, Computer Oriented Numerical Methods

Course Outcome:

1. After successful completion of this course students will be able to solve chemical engineering problems involving linear and non-linear equations and solve ordinary differential equations.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1							2		
1-Weak, 2- Moderate, 3-Strong															

CH204TPC04 **Thermodynamics – II** **[L:3, T:0, P:0]**

Objectives:

To introduce the concepts of fugacity. activity coefficient, vapour-liquid equilibrium and reaction equilibrium.

Unit I: Thermodynamic Potentials: Postulates, intensive properties, criteria of equilibrium. free energy functions and their significances in phase and chemical equilibria, Euler relation, Gibbs-Helmholtz equation, Gibbs free energy minimum principle. Maxwell relations, Various TDS equations, Cp and Cv relations.

Unit II: Thermodynamic Properties of Gases and Liquids: Joule-Thompson coefficient, Clausius - Clapeyron equations and some important correlations for estimation of vapour pressures, estimation of thermodynamic properties by using equations, graphs and tables.

Unit III: Multicomponent Mixtures: Partial molar properties, partial molar Gibbs free energy, chemical potential and its dependence on temperature and pressure, fugacity and its calculation, dependence of fugacity on temperature & pressure. Gibbs phase rule and its significance.

Unit IV: Properties of Solutions: Ideal solutions (Lewis Randall Rule) phase equilibrium in ideal solutions, phase equilibrium problems, excess properties, Gibbs-Duhem relation, activity & activity coefficient, dependence of activity coefficient on temperature and composition, excess Gibbs free energy models: UNIOUAC and UNIFAC methods, Margules, Van laar. Wilson and NRTL equations, Herny's Law.

Unit V: Chemical Equilibrium: Equilibrium constants in terms of measurable properties, variation of equilibrium constants with temperature and pressure, adiabatic reactions. equilibrium in homogeneous & heterogeneous reactions.

Suggested Text Books

1. J. M. Smith, H. C. Van Ness & M. M. Abbott, Introduction to Chemical Engineering Thermodynamics. McGraw-Hill International Edition.
2. Y. V. C. Rao, Chemical Engineering Thermodynamics, University Press.
3. K. V. Narayanan. A Textbook of Chemical Engineering Thermodynamics, PHI.

Suggested Text Books

1. R.C. Srivastava, “Thermodynamics a core course". PHI.
2. P. K. Nag. Engineering Thermodynamics, Tata McGraw Hill.

Course Outcomes:

Students should be able to understand

1. Understand and calculate the various thermodynamics potentials.
2. Analvse the thermodynamic properties of gases and liquids.
3. Estimate the partial molar properties of gases and liquid.
4. Application of various equation of state.
5. Evaluate the equilibrium constant for chemical reactions.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3							3	3	3	
CO2	3	3	3	2	3							3	3	3	
CO3	3	3	3	2	3							3	3	3	
CO4	3	3	3	2	3							3	3	3	
CO5	3	3	3	2	3							3	3	3	
1-Weak, 2- Moderate, 3-Strong															

CH204TPC05 Particle and Fluid Particle-Processing [L:3, T:1, P:0]

Objectives

Objective of this course is to introduce students to the numerous industrial operations dealing with the particulate solids, their handling in various unit operations, and those in which particle fluid interactions are important.

Contents:

Unit I : **Solids Properties, Handling, Mixing**: Introduction: Relevance of fluid and particle mechanics, and mechanical operations in chemical engineering processes. Solid particle characterization: Particle size, shape and their distribution, Screen analysis, standard screens; Relationship among shape factors and particle dimensions; Specific surface area; Measurement of surface area. Mixing and storage of Solids: Types of important mixers like kneaders, dispersers, masticaters, roll mills, muller mixer, pug mixer, blender, screw mixer etc., mixing index.

Unit II : **Storage and Transportation, Size reduction** : Types of storage equipment, Bin, Silo, Hoper, etc. Transport of fluid solid systems: mechanical conveying, pneumatic and hydraulic conveying. Major equipment's- Crushers, grinders, ultrafine grinders, laws of communition, Close circuit and open circuit grinding.

Unit III: **Fluid-Solid Separation**: Sedimentation: Elutraition, Classification and sedimentation, Free Settling, hindered settling, flow of solids through fluid, Stoke's law, Richardson-Zaki equation, design of settling tanks, Centrifugal separation, design of cyclones and hydrocyclones, filter bags, venture scrubber, electrostatic Precipitator.

Unit IV : **Mechanical separation and Filtration**: Industrial screen; their capacity and effectiveness. Types of filtration, principle of filtration, plate and frame filter, leaf filter, rotary drum filter, etc.

Unit V : **Fluidization**: Fluidized bed, minimum fluidization velocity, pressure drop etc. Types of fluidization: Particulate fluidization, Bubbling fluidization, Applications of fluidization. Packed bed: Void fraction, superficial velocity, channelling, Ergun equation and its derivation, Kozeny Carman equation, Darcy's law and permeability, Blaine's apparatus.

Suggested Text Books

1. W. McCabe, J. Smith, & P. Harriott, Unit Operations of Chemical Engineering, 6th edition, McGraw Hill.

2. Coulson and Richardson's Chemical Engineering, Vol. 2, Butterworth-Heinemann, 5th edition 2002.

Suggested References Books

1. M. J. Rhodes, "Introduction to Particle Technology", 2nd edition, John Wiley, Chichester; New York.

2. T. Allen, "Powder Sampling and Particle Size Determination", Elsevier.

3. H. Masuda, K. Higashitani, H. Yoshida, "Powder Technology Handbook",CRC, Taylor and Francis.

4. D. Vollath, Nanomaterials: An Introduction to Synthesis, Properties and Applications, 2nd Ed., Wiley.

Course Outcomes

Students will be able to

1. Calculate pressure drop in fixed and fluidized beds

2. Know the significance and usage of different particulate characterization parameters, and equipment to estimate them
3. Describe Size reduction energy requirements, estimate performance of equipment, selection and sizing of equipment.
4. Analyse filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	1		1							2	2	
CO2	1	2	1	1		1							2	2	
CO3	3	3	1	1		1							2	2	
CO4	3	2	1	1		1							2	2	
1-Weak, 2- Moderate, 3-Strong															

CH204TPC06 **Process Instrumentation** **[L:3, T:1, P:0]**

Obiectives:

This course is to introduce students to learn the basics of instrumentation and handling the process variables, course address fundamentals & amp: operation of different measuring devices such as temperature, level, pressurc, flow, pH. humidity and compositions. Course introduced to impart basic knowledge of transmitters, transducers, control valves, digital and analog components related to PLC. DOS.

Unit I : Instruments Characteristics: Introduction to process variables, static and dynamic characteristics of instruments, and their general classification, elements of measuring system and their functions.

Unit I1: Transmitters & amp; Transducers: Signal transmission, transmitters, electronic, pneumatic, transducers

Unit III: Measuring Instruments: Principles, construction and operations of instruments for the measurement of various process variables such as temperature, pressure, flow, liquid level, humidity, viscosity and composition.

Unit IV: Controllers & amp: Regulators: Principles and construction of electro- pneumatic controllers, multiplexers, final control elements such as pneumatic control vale. Stepper motor.

Unit V: Data Acquisition & amp; Analysis : Introduction to data acquisition system and intelligent instruments, instrumentation of process equipment such as distillation column heat exchanger etc.

Text Books:

1. S. K. Singh. Industrial Instrumentation and Control, McGraw-Hill.

2. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGrawHill

References Books:

1. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw-Hill Publishing Co.

Lid

2. T. G. Beckwith, R. D. Marangoni & J. H. Lienhard, Mechanical Measurements, Addison Wesley.

3. R. K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi

4. C. D. Johnson, Process Control Instrumentation Technology, Pearson Education, Inc.

Outcomes:

1. Students will be well-familiar with instrumentation and automation as relevant to modern plan operation.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	2	3	2							3	2	
CO2	3	3	2	2	2	2							3	2	
Weightage: 1-Slightly; 2-Moderate; 3-Strongly															

CH204PBS03 Numerical Methods in Chemical Engineering Lab [L:0, T:0, P:2]

Objective:

The course would enable students to write their own computer programs using programming languages like C and commercial software like Matlab. Hands-on experience will be provided to apply these computer programs to solve problems in different areas of chemical engineering e.g. fluid flow, heat and mass transfer, chemical reaction engineering etc.

List of Experiments:

1. Write a program in 'C' to find simple interest
2. Write a program in 'C' to calculate sum of three numbers
3. Write a program in 'C' to calculate number of months and days
4. Write a program in 'C' to find whether a year is leap year or not
5. Write a program in 'C' to convert the given temperature in Fahrenheit to Celsius
6. Write a program in 'C' to find whether a number is odd or even
7. Write a program in 'C' to calculate factorial of a given number
8. Write a program in 'C' to find the real roots of a quadratic equation
9. Write a program in 'C' to for Secant Method
10. Write a program in 'C' and 'MATLAB' to for Newton Raphson Method
11. Write a program in 'C' to for Regula falsi Method
12. Write a program in 'C' and 'MATLAB' to for Gauss Elimination and Gauss Seidal Methods
13. Write a program in 'C' to for Lagrange's Interpolation
14. Write a program in 'C' and 'MATLAB' to for Simpson's Rule
15. Write a program in 'C' and 'MATLAb' to for Euler's Method and Runge-Kutta Method

Any other experiments may be added further, if needed.

Course Outcome:

Students will be able to solve chemical engineering problems involving Linear and non-linear equations and solve ordinary differential equations using programming languages like C and software like MATLAB.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	3								2	2	
1-Weak, 2- Moderate, 3-Strong															

CH204PPC03 Particle and Fluid Particle-Processing Laboratory [L:0, T:0, P:3]

Objectives:

1. To understand the working and importance of various mechanical operations used in process industry.
2. To apply principles of basic sciences and chemical engineering for designing various size reduction, size separation and filtration equipment.

List of Experiments

1. To verify laws of crushing for crushing solid particles in Jaw crusher.
2. To verify laws of crushing for crushing solid particles in roll crusher.
3. To verify laws of crushing for crushing solid particles in Ball mill.
4. To find out the Effectiveness of Triple deck Vibrating Screen.
5. To determine the average diameter of a mixture of solid particles of different size using sieve analysis.
6. To determine the collection efficiency at different flow rate for separating dust particles from air.
7. To study the working of continuous Rotary Vaccum Drum Filter.
8. To determine the filter medium resistance and specific cake resistance of plate and frame filter press.

Outcomes:

At the end of the laboratory course students will be able

1. To apply the principles of unit operations through experimentation.

2. To demonstrate the ability to understand the various mechanical operation equipments used in chemical and allied process industry.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	1		1			1				2	2	
CO2	1	2	1	1		1			1				2	2	
1-Weak, 2- Moderate, 3-Strong															

CH204PPC04 Process Instrumentation Lab [L:0, T:0, P:3]

Course Objectives:

To help the student to enhance their knowledge of different process measuring instruments that used in industry

Content:

1. Study of Mercury in glass thermometer with different temperature range.
2. Study the characteristics of various flow measuring instruments
3. Study the characteristics LVDT, Strain gauge
4. Study the characteristics of Level meter, pH meter, Density meter
5. Study the characteristics of different thermocouples & RTD sensors.
6. Determination of transient response of bimetallic thermocouple.
7. Determination of dissolved oxygen using DO meter.
8. Concentration analysis of gas-liquid chromatograph.
9. Concentration analysis using U-V-visible Photo-spectrometer & to study its principle of operation.
10. Measurement of Humidity using hair hygrometer & to study its principle.
11. Pressure measurement using different pressure gauges, U-tube manometer, pressure transducer and study of their characteristics.

Any other experiments may be added further, if needed.

Outcomes:

Practical experiences and soft skills associated with this course, the student able to demonstrate the following industry oriented COs associated with course.

1. Able to understand the characteristics of instrument for various chemical processes.
2. Able to understand the temperature measuring instruments in chemical industry.
3. Able to understand the pressure, Level, pH etc. various measuring instruments in chemical industry.
4. Measure the flow and level using various measuring instruments in chemical industry.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	3	2			1				3	2	
CO2	3	3	2	2	2	2			1				3	2	
CO3	3	1	2	2	3	2			1				3	2	
CO4	3	3	2	2	2	2			1				3	2	
Weightage: 1-Slightly; 2-Moderate; 3-Strongly															

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (Effective from session 2022-23)

B. TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

THIRD YEAR, FIFTH SEMESTER (AICTE-NEW)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
						Sessional			
	THEORY		L	T	P	IA	ESE	TOTAL	
01.	CH305TPC07	Heat Transfer	3	1	0	30	70	100	4
02.	CH305TPC08	Mass Transfer-I	3	1	0	30	70	100	4
03.	CH305TPC09	Chemical Reaction Engineering-I	3	1	0	30	70	100	4
04.	CH305TPC10	Process Equipment Design-I	3	1	0	30	70	100	4
05.	CH305TPE1X		3	0	0	30	70	100	3
06.	CH305TPE2X		3	0	0	30	70	100	3
	PRACTICAL								
01.	CH305PPC05	Heat Transfer Lab	0	0	3	30	20	50	1.5
02.	CH305PPC06	Chemical Reaction Engineering Lab	0	0	3	30	20	50	1.5
		Total	18	4	6	240	460	700	25

IA – Internal Assessment **ESE - End Semester Examination** **Total Credits – 25**

Total Marks – 700 **Total Periods / week - 28**

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (Effective from session2022-23)

B. TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

THIRD YEAR, SIXTH SEMESTER (AICTE)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
						Sessional			
	THEORY		L	T	P	IA	ESE	TOTAL	
01.	CH306TPC11	Mass Transfer -II	3	1	0	30	70	100	4
02.	CH306TPC12	Process Dynamics and Control	3	1	0	30	70	100	4
03.	CH306TPC13	Chemical Reaction Engineering-II	3	1	0	30	70	100	4
04.	CH306TPE3X		3	0	0	30	70	100	3
05.	CH306TMC02	Essence of Indian Knowledge Tradition	2	0	0	0	0	0	0
06.		Open Elective	3	0	0	30	70	100	3
	PRACTICAL								
01.	CH306PPC07	Mass Transfer Lab	0	0	3	30	20	50	1.5
02.	CH306PPC08	Process Dynamics and Control Lab	0	0	3	30	20	50	1.5
		Total	17	3	6	210	390	600	21

IA – Internal Assessment

ESE - End Semester Examination

Total Credits – 21

Total Marks – 600

Total Periods / week – 26

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

DEPARTMENT OF CHEMICAL ENGINEERING

List of Professional Elective Courses (Fifth and Sixth Semester)

S.No.	Semester	Course No.	Subjects
01.	V	CH305TPE11	Engineering Materials
02.		CH305TPE12	Polymer Technology
01.	V	CH305TPE21	Inorganic Chemical Technology
02.		CH305TPE22	Fluidization Engineering
01.	VI	CH306TPE31	Organic Chemical Technology
02.		CH306TPE32	Fuel Combustion Energy Technology

List of open electives for 6th semester B.Tech students (Chemical Engineering Students)

S.No	Course code	Course name	Offered by
1	CE206TOE01	Metro systems and Engineering	Civil
2	CS206TOE01	Object Oriented Programming with C++	CSE
3	EC206TOE01	Introduction to electronic devices and circuits	ECE
4	IP206TOE01	Operation Research	IPE
5	IT206TOE01	Computer Graphics	IT
6	ME206TOE01	Automobile Engineering	MECH

List of open electives for 6th semester B.Tech students (Other Branch Students)

S.No	Course code	Course name	Offered by
1	CH206TOE01	Industrial utilities and safety	Chemical

Program Outcomes	
PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering comm Modules and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Program Specific Outcomes	
PSO1	The students of the programme will have a strong foundation in mathematics, basic sciences and chemical engineering to meet the current demands in professional world with cutting-edge research in chemical and allied engineering disciplines.
PSO2	Graduates would be equipped with a working knowledge in professional courses such as process economics, project engineering, industrial safety and sustainable development to work in the conventional as well as frontier area of Chemical Engineering which enables them suitable for chemical industries.
PSO3	Graduates of chemical engineering will be able to communicate in a professional setting, including soft skills, technical writing, presentation, and management skills making them employable to industries.

B.Tech. V Semester

CH305TPC07 **Heat Transfer** **[L:3, T:1, P:0]**

Objectives

1. To provide a fundamental understanding of heat transfer by conduction, convection and radiation.
2. To understand the fundamental laws, their correlations, and applications.
3. To study the general design of heat exchanger, evaporator, and condenser.

Contents:

Unit-I: Introduction to three modes of heat transfer, Derivation of heat balance equation- steady one-dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Unit-II: Heat convection, boundary layers, Forced convection, Natural convection, Dimensionless parameters for forced and free convection heat transfer, Correlations for forced and free convection, Approximate solutions to laminar boundary layer equations (momentum and energy), Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Unit-III: Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.

Unit-IV: Heat Transfer Equipment: Types of heat exchangers, General design of parallel and counter-current, Double pipe and Shell and Tube heat exchanger, Analysis and design of heat exchangers using both LMTD and ε- NTU methods, Similarity between heat and mass transfer.

Unit-V: Heat Transfer with phase change: Evaporation- Types of evaporators and fields of their applications, Single and multiple effect evaporators: their design and operation, Vapour recompression, Heat transfer from condensing vapours, Heat transfer to boiling liquids. Boiling and Condensation heat transfer, Pool boiling curve.

Text Books :

1. Unit Operations of Chemical Engineering by W. L. McCabe, J. C. Smith and P. Harriot, McGraw Hill Education.
2. A Heat Transfer Textbook, Third Edition, by John H. Lienhard IV and John H. Lienhard V,

Phlogiston Press, Cambridge, Massachusetts, U.S.A.

Reference Book:

1. Fundamentals of Momentum, Heat and Mass Transfer by J. R. Welty, C. E. Wicks, R. E. Wilson and G. L. Rorrer, John Wiley & Sons.
2. Principles of Heat Transfer, Seventh Edition, by Frank Kreith, Raj M. Manglik, Mark S. Bohn, Global Engineering, Cengage Learning, Stamford, USA.
3. Fundamentals of Heat and Mass Transfer, Frank P. Incropera, David P. Dewitt, Theodore L. Bergman, Adrienne S. Lavine, John Wiley & Sons; 6th edition.
4. Heat Transfer-A Practical Approach, Yunus A. Cengel, McGraw Hill, Second Edition.

Course Outcome:

Students would be able to

1. Analyze the steady state and unsteady state heat transfer by conduction.
2. Calculate heat transfer coefficients for forced and natural convection.
3. Explain and Calculate the heat transfer by radiation.
4. Design and analyze the double pipe and shell and tube heat exchanger performance for co-current and counter-current flows.
5. Analyze the of heat transfer equipment with phase change.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1		1						2	1	
CO2	3	2	2	1	1		1						2	1	
CO3	3	2	2	1	1		1						2	1	
CO4	3	2	2	1	1		1						2	1	
CO5	2	2	2	1	1		1						2	1	
Weightage: weak-01, moderate-02, strong-03															

CH305TPC08 Mass Transfer-I [L:3, T:1, P:0]

Objectives

1. To provide the understanding of mass transfer operations and equipments.
2. To impart the understanding of separation processes such as diffusion, distillation and absorption.

Contents:

Unit-I: Constitutive laws of diffusion; unsteady state diffusion, molecular diffusion in gases and liquids, Diffusion velocities, Convective mass transfer, interphase mass transfer and mass transfer coefficients, mass transfer correlations.

Unit-II: Phase Equilibria: Vapor-liquid equilibrium curves and boiling point diagram, Volatility, Solubility of gases, Enthalpy-concentration diagrams. Equilibrium Stage Operations Principles, Determination of number of ideal stages for two-component systems by graphical and absorption factor methods.

Unit-III: Flash distillation, differential distillation, steam distillation, Azeotropic distillation and Extractive distillation, Continuous distillation with rectification, Reflux ratio, Minimum reflux ratio, calculation of number of plats – Lewis sorel method, McCabe Thiele method.

Unit-IV: Fenske equation, Optimum reflux ratio, Analysis of fractionating column by enthalpy concentration diagram method, Plate efficiencies, Packed Column, Height Equivalent to Theoretical Plate.

Unit-V: Gas Absorption: Design of packed towers, Principles of absorption, Rate of absorption, Two film theory, Overall coefficients, HTU method, Interrelation between heat transfer, momentum transfer and mass transfer.

Suggested Text Books :

1. Principles of Mass Transfer and Separation Processes by B. K. Dutta, PHI Learning Private Limited.
2. Mass Transfer Operations by R. E. Treybal, McGraw Hill.
3. Diffusion - Mass Transfer in Fluid Systems by E.L. Cussler, Cambridge University Press.
4. Principles of Unit Operations by A. S. Foust, A. L. Wenzel, C. W. Clump, L. Maus and L. B. Anderson, John Wiley & Sons.

Course Outcome:

Students would be able to

1. Explain the basics of mass transfer and related laws.
2. Identify the concepts of phase equilibrium in mass transfer related problems.
3. Understand the molecular diffusion phenomena and binary separation principles of distillation and absorption operation.
4. Solve problems related to distillation, diffusion and absorption and mass transfer equipment.
5. Design plate/packed column for adsorption and distillation operation.

.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	1							3	2	
CO2	3	3	2	2	2	2							3	2	
CO3	3	2	2	1	1	1							3	2	
CO4	3	2	3	1	2	1							3	2	
CO5	3	2	2	1	1	1							3	2	
Weightage: weak-01, moderate-02, strong-03															

CH305TPC09 Chemical Reaction Engineering-I [L:3, T:0, P:0]

Objectives

To impart the knowledge of the kinetics and thermodynamics of single and multiple reaction and the effect of temperature and pressure on reaction systems.

Contents:

Unit-I: Kinetics of Homogeneous Reactions: Kinetics and thermodynamics of chemical reactions, Kinetics of homogenous reactions rate theories, Analysis of rate equations.

Unit-II: Interpretation of Batch Reactor Data: Irreversible reactions, Total pressure method of kinetic studies, Analysis of complex rate equations, Complex reactions, Chain reactions, Variable volume reactions, Rate constants and equilibrium.

Unit-III: Ideal Reactor for Single Reaction: Ideal batch reactors, Steady state mixed flow reactor, Steady state plug flow reactor, Size comparison of single reactors, Multiple-reactor system.

Unit-IV: Design for Multiple Reaction: Introduction to multiple reaction, Qualitative treatment of product distribution and reactor size for parallel reactions, Reversible first order reactions in series, Favourable contacting patterns for irreversible reactions in series (First order & followed by first order).

Unit-V: Temperature and Pressure Effects: Single reaction, General graphical design procedure, Optimum temperature progression, Heat effects- adiabatic and non-adiabatic operations.
Multiple reactions: Temperature and vessel size for maximum production.

Suggested Text Books :

1. Chemical Reaction Engineering by O. Levenspiel, John Wiley & Sons.
2. Elements of Chemical Reaction Engineering by H. S. Fogler, Prentice Hall.
3. Chemical and Catalytic Reaction Engineering by J. J. Carberry, Dover Publications.
4. Chemical Reactor Analysis and Design by G. F. Froment, K. B. Bischoff and J. D. Wilde, Wiley.

Reference Book:

1. Reaction Kinetics for Chemical Engineers by S. M. Walas, Butterworths Publishers.

Course Outcome:

Students would be able to

1. Develop rate of reaction for homogeneous reactions.
2. Interpret batch reactor data and design ideal reactors for single and multiple reactions.
3. Describe different aspects of design for multiple reactions.
4. Explain the effect of temperature and pressure on reaction rate.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1		1					1	2	1	1
CO2	3	3	3	2	1		1						3	2	1
CO3	3	3	3	1	1		1						3	2	1
CO4	3	2	2	1	1		1						2	1	1

Weightage: weak-01, moderate-02, strong-03

CH305TPC10 Process Equipment Design-I [L:3, T:0, P:0]

Objectives

To impart knowledge of various process pressure vessel
To understand the various supports which used in pressure vessel
To understand the chemical engineering principles applicable to mechanical process design for various pressure vessels and standard codes for design of chemical plant equipment.

Contents:

Pressure and Storage Vessels: Design of pressure and storage vessels and their supports.
End closures, Flat plates, Flanged, Dished, Hemispherical, Ellipsoidal and conical ends.

Suggested Text Books :

1. Introduction to Chemical Equipment Design (Mechanical Aspects) by B.C. Bhattacharya, Chemical Engineering Education Development Center.
2. Process Equipment Design by L.E. Brownell and E.H. Young.
3. Design of Process Equipment Design by M.V. Joshi and V.V. Mahajan, MacMillan, India
4. Chemical Engineering by J. M. Coulson and J. F. Richardson, Vol-I, MacMillan, Newyork.
5. Process Equipment Design by S.D. Dawande, Dennet & Co.

Reference Books:

1. Perry's Chemical Engineers' Handbook by D. W. Green and R. H. Perry, McGraw Hill Publication.
2. IS Codes.

Course Outcome:

Students would be able to

1. Determine the various parameter of pressure vessel
2. Design of different kind of closure used in pressure vessel
3. Understand the design of storage vessels and their supports.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	3	2							3	2	
CO2	3	3	2	2	2	2							3	2	
CO3	3	3	2	2	2	2							3	2	
Weightage: weak-01, moderate-02, strong-03															

CH305TPE11 Engineering Materials [L:3, T:0, P:0]

Objectives

1. To provide the understanding of material selections for construction to execute a task for a particular application, its properties and behaviour at different circumstances.
2. Properties, behaviour and maintenance of various engineering materials.

Contents:

Unit-I: Crystalline and Non-Crystalline Materials: Crystalline state, Atomic bonding, Bravias lattices, Miller indices, Structure of some common inorganic compounds, Structural imperfections. Economic, environmental and social issues of material usage.

Unit-II: Mechanical properties of materials and their variation with temperature, importance and limitations of these properties on material selection for a particular application. Failure of materials: Failure of materials under service conditions.

Unit-III: Corrosion: Mechanism of corrosion, Types of corrosion, Factors influencing corrosion, Methods of corrosion control, Inhibition and other precautionary measures.

Unit-IV: Non-Ferrous Metals: Copper, Brasses, Bronze, Aluminium, their mechanical properties, Workability and applications, Corrosion resistance. Non-metallic materials of construction.

Unit-V: Phase diagram: Phase rules, Equilibrium phase diagram, cooling curves and their relations to properties of metals and alloys, Iron-carbon equilibrium diagram. Response of materials to chemical environment.

Suggested Text Books :

1. Introduction to Materials Science for Engineers by James F. Shackelford, Pearson.
2. Elements of Materials Science and Engineering by L.H.Van Vlack, Pearson.
3. Materials Science and Engineering by V. Raghavan, PHI Learning Private Limited.
4. Materials Science for Engineers by L. H. VanVlack, Addison-Wesley Publishing Co.
5. Chemistry of Engineering Materials by A. M. Sikkander and T. N. Balu, Raj Publications.
6. Corrosion, Prevention and Control by K.S. Rajagopalan, Scientific Surveys Limited.
7. Corrosion Engineering by M. G. Fontana, McGraw Hill Education.

Reference Book:

1. Perry's Chemical Engineers' Handbook by D. W. Green and R. H. Perry, McGraw Hill Publication.

Course Outcome:

Students would be able to

1. Explain different types of materials and their mechanical properties and limitations.
2. Explain types of corrosion and various methods to control them.
3. Describe phase diagram and its significance.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		2			1						1	1	
CO2	2	1		2			1						1	1	
CO3	2	1		2			1						1	1	

Weightage: weak-01, moderate-02, strong-03

CH305TPE12 Polymer Technology [L:3, T:0, P:0]

Objectives

To develop the abilities required for production, processing, properties testing and Environmental effects of polymers and its manufacturing Industries.

Contents:

Unit-I: Introduction to Polymer Science: Classification of polymer and functionality, Polymerization, Polymer structure, Molecular weight distribution and thermal transition types.

Unit-II: Polymer Synthesis: Step and Chain growth polymerization and its kinetics, Copolymerization and its kinetics, Reaction mechanism of synthetic Polymer.

Unit-III: Conformation, Solution and Molecular Weight: Thermodynamics of polymer solution, Flory Huggins theory, Process of polymer dissolution, Nature of polymer molecules in solution, Measurement of molecular weight, Osmometry, Light scattering, GPC, and Viscosity of dilute polymer solution.

Unit-IV: Solid State Properties : Amorphous state, Glass transition temperature, Glassy solid and glass transition, The crystalline state, Crystal melting temperature, Degree of crystallinity & its effect on properties of polymer.

Unit-V: Polymer Degradation & the Environmental Effect: Polymer stability and types of degradation. The management of plastics and its effect on environment, biodegradation.

Suggested Text Books :

1. Polymer Science & Technology by J. R. Fried, Prentice Hall.
2. Outlines of Polymer Technology: Manufacture of Polymers by R. Sinha, PHI Learning Private Limited

Course Outcome:

Students would be able to

1. Describe types of polymerization and synthesis
2. Explain kinetics and thermodynamics of polymerization.
3. Apply mechanisms of polymer degradation and environmental effect.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1			1						1	1	
CO2	3	2	1	1			1						1	1	
CO3	2	1		1			3						1	1	

Weightage: weak-01, moderate-02, strong-03

CH305TPE21 Inorganic Chemical Technology [L:3, T:0, P:0]

Objectives

Contents:

Unit-I: Sulfur and Sulfur Chemicals : Sulfur, Sulfuric acid, SCSA, DCDA processes, Sodium thiosulfate, Alums.
Marine Chemical Industries : Common salt, Chemicals from sea bittern.

Unit-II: Industrial Gases and Selected Inorganic Chemicals : Manufacture and use of Hydrogen, Carbon dioxide, Acetylene, Oxygen, Nitrogen and inert gases, Inorganic chemicals: Barium, boron, chromium, lithium, manganese.

Unit-III: Fertilizers : Status of industry, Grading and classification of fertilizers, Raw materials, Hydrogen production, Fixation of nitrogen, Synthesis, Ammonia based fertilizers, Phosphoric acid, Phosphatic and other fertilizers: SSP, TSP, UAP, DAP and nitro-phosphate, Potash fertilizers, NPK, Corrosion problems and Materials of construction, Bio-fertilizers.

Unit-IV: Soda Ash : Manufacturing, Special materials of construction, Solvay and modified Solvay process, Environmental consideration, Corrosion problems and materials of construction.
Chlor Alkali Industry : Electrochemistry of brine electrolysis, Current efficiency, Energy efficiency, Diaphragm cells, Mercury cells, Mercury pollution and control, Caustic soda, Chlorine, Hydrochloric acid, Corrosion problems and materials of construction

Unit-V: Cement, Glass and Refractory: Manufacturing, Environmental consideration, Corrosion problems, Engineering problems and materials of construction.

Suggested Text Books :

1. R.N. Shreve & I. A. Brink, "Chemical Process Industries"
2. Chem Tech I, II, III, IV- IIT. Madras
3. Dryden Co. M. G. Rao and M. Sitting, "Outlines of Chemical Technology".

Course Outcome:

Students would be able to

1. Impart the basic concepts of chemical technology.
2. Develop understanding about unit process and unit operations in various industries.
3. Describe the processes involved in manufacturing of various inorganic chemical and various chemical reactions involved in the process.
4. Draw the process flow diagrams and understand the major engineering problems encountered in the processes.
5. Explain important process parameters such as raw materials, environmental considerations, MOC, etc..

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	3	3	3	3		1	3	3	3	1
CO2	3	2	1	2	2	1	3	3	2			1	2	2	1
CO3	3	2	3	2	2	1	2	1		1	1	2	3	2	1
CO4	3	2	1			1		1				1	2	2	
CO5	3	2	3	2	2	1	2			1	1	2	3	2	1

Weightage: weak-01, moderate-02, strong-03

CH306TPE22 Fluidization Engineering [L:3, T:0, P:0]

Objectives

To impart the fundamental knowledge of Fluidization and understand the different aspects of fluidized bed systems applied in various industries.

Contents:

Unit-I: Phenomenon of Fluidization, Advantages and disadvantages of fluidization compared to conventional processes, Classification of various industrial beds, Industrial applications of fluidized beds in mineral processing, coal and biomass gasification & combustion FCC petroleum refining, pharmaceuticals, cement and other solid handling systems, Fluidized Bed Drying.

Unit-II: Gross behavior of fluidized beds-Minimum fluidizing velocity and pressure drops; Voidage, Design of distributors, Effect of temperature and pressure on fluidized bed, Elutriation and entrainment Transport disengaging height.

Unit-III: Bubbles in dense beds-Davidson Model, stream of bubbles, Bubbling bed models, Geldart classification, Different regimes of Fluidization, Davidson's model, Variation of Bubbling bed and Circulating Fluidized beds.

Unit-IV: Emulsion phase, Turn-over rate of solids, Residence Time Distribution of Solids, Diffusion model of solids movement, Interchange coefficient of solid into and out of wake.

Unit-V: Flow Pattern of Gas through fluidized beds, diffusion model for gas flow; two region models, evaluation of interchange coefficients, Heat and Mass transfer in Fluidized Beds.

Suggested Text Books :

1. Fluidization Engineering by D. Kunii and O. Levenpiel, Butterworth-Heinemann, Elsevier.

Reference Book:

1. Fluidization by J. F. Davidson and D. Harrison, Academic Press.
2. Fluidization and Fluid Particles Systems by F.A. Zenz and D. F. Othmer, Reinhold Publishing.
3. Handbook of Fluidization and Fluid-Particle Systems, by W. C. Yang, CRC Press.

Course Outcome:

Students would be able to

1. Describe fluidization and its recommendation in various industries exploiting its various advantages evaluating the heat and mass transfer aspects.
2. Apply model equations for fluidized beds for application in various industries.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
CO2	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
Weightage: weak-01, moderate-02, strong-03															

CH305PPC05 Heat Transfer Lab [L:0, T:0, P:3]

Objectives

To provide the knowledge of working of heat transfer equipment and the application of heat transfer correlations.

Content:

1. Determination of dirt factor of a parallel and counter flow double pipe heat exchanger.
2. Determination of dirt factor of a shell and tube heat exchanger.
3. Study of thermal conductivity of a metal bar.
4. Calculation and comparison of heat transfer coefficient for drop-wise and film-wise condensation.
5. Study the unsteady state heat transfer.

Outcomes:

Students would be able to

1. Handle the heat transfer equipment and calculate the heat transfer coefficients.
2. Apply the heat transfer correlations for calculating the heat transfer rate.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2		1			1		1				2	1	
CO2	2	2		1			1		1				2	1	
Weightage: weak-01, moderate-02, strong-03															

CH305PPC06 Chemical Reaction Engineering Lab [L:0, T:0, P:3]

Objectives

To impart knowledge on kinetics and design of reactors.

Contents:

1. Kinetics studies in a batch reactor.
2. Kinetics studies in a plug flow reactor.
3. Kinetics studies in a CSTR.
4. Study of temperature dependence of rate constant.

Course Outcome:

Students would be able to

1. Get a sound working knowledge of different types of reactors.
2. Maintain the kinetic parameters of various reactions.
3. Use the batch reactor data to determine the order of reactions.
4. Use the relevant parameters for the design of reactors.
5. To select suitable reactor for various applications.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2		1			1		1				2	1	
CO2	2	2		1			1		1				2	1	
CO3	2	2		1			1		1				2	1	
CO4	2	2		1			1		1				2	1	
CO5	2	2		1			1		1				2	1	
Weightage: weak-01, moderate-02, strong-03															

B.Tech. VI Semester

CH306TPC11 Mass Transfer-II [L:3, T:1, P:0]

Objectives

1. To provide basic knowledge of fundamental mass transfer operations and mechanisms.
2. To understand the mass transfer in LLE, leaching, drying, crystallization, adsorption and humidification operation.

Contents:

Unit-I: Humidification Operations: Definitions, Humidity chart and its use in measurement of humidity and calculations of humidification operations, Adiabatic humidification, Design of Cooling Towers.

Unit-II: Leaching: Equipment, Principles of leaching, Calculation of number of ideal stages, Stage efficiency

Unit-III: Liquid- Liquid Extraction: Equipment, Principles of extraction, Panchon-Savorit method, Counter-current extraction using reflux application of McCabe method, Extraction in packed and spray column.

Unit-IV: Crystallization: Principles, yield of crystals, Super solubility curve, Crystal growth, Equipment and application of principles to design.
Adsorption: Fixed bed adsorbers, break through; Ion-Exchange.

Unit-V: Drying: Equipment, Principles, Mechanism and theory of drying, Calculation of drying time.

Suggested Text Books :

1. Principles of Mass Transfer and Separation Processes by B. K. Dutta, PHI Learning Private Limited.
2. Mass Transfer Operations by R. E. Treybal, McGraw Hill.
3. Diffusion - Mass Transfer in Fluid Systems by E.L. Cussler, Cambridge University Press.
4. Principles of Unit Operations by A. S. Foust, A. L. Wenzel, C. W. Clump, L. Maus and L. B. Anderson, John Wiley & Sons.

Course Outcome:

Students would be able to

1. Explain the basics of humidification, drying, leaching, crystallization and adsorption.
2. Identify the mechanisms of mass transfer, formulate rate equations.
3. Solve problems related to humidification, drying, leaching and crystallization.
4. Design equipment for humidification, drying, leaching and crystallization.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1							3	2	
CO2	3	3	2	2	2	2							3	2	
CO3	3	2	3	1	2	1							3	2	
CO4	2	2	2	1	2	1							3	2	

Weightage: weak-01, moderate-02, strong-03

CH306TPC12 Process Dynamics and Control [L:3, T:1, P:0]

Objectives

1. To provide fundamental knowledge on process control strategies.
2. To impart knowledge on a theoretical analysis of open loop and closed loop systems.

Contents:

Unit-I: Process Control : Importance of process control in chemical plants and systems, Various types of Control systems viz. open loop and closed loop control, feedback and feed forward control, servo and regulator control; Importance of dynamic behaviour of processes in process control, Physical and block diagram representation of control system, Use of Laplace transformation in analysis of control systems.

Unit-II: Simple System Analysis: Laplace transformation and transfer function, Block diagrams, Linearization, First and higher order systems, Interacting and non-interacting systems, Distributed and lumped parameters systems, Dead time.

Unit-III: Linear Open Loop Systems: Response of first order, second order and higher order systems, Linearization of non-linear systems, Transportation lag. Linear Closed Loop Systems: Study of various control system and their components viz. controllers, final control elements, Measuring instruments, Closed loop transfer functions, Transient response of simple control system, Stability criterion and analysis.

Unit-IV: Root Locus, Stability Criterion and Transient Response: Transient response analysis form root locus, Application of root locus to control system, Routh stability criterion.

Unit-V: Frequency Response Analysis: Design of control system by frequency response, Closed loop response by frequency response, Frequency response technique: Phase margin and gain margin, Bode stability criterion; Nyquyist stability criterion, Controller tuning: Ziegler-Nichols method, Cohen-Coon method, Introduction to advanced controllers: cascade control, feed forward control, Introduction to artificial intelligence.

Suggested Text Books :

1. Process Systems Analysis and Control by D.R. Coughanowr and S. LeBlanc, McGraw-Hill.
2. Process Dynamics and Control by D.E. Seborg, T.F. Edgar and D.A. Mellichamp, John Wiley.
3. Chemical Process Control: An Introduction to Theory and Practice by G. Stephanopoulos, Pearson Education.

Course Outcome:

Students would be able to

1. Evaluate dynamic behaviour of first and second order system.
2. Determine the process stability in Laplace domain.
3. Analyze open-loop systems and linear closed loop systems.
4. Develop working knowledge of control system by frequency response.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1		1						2	1	
CO2	2	2	1	1	1		1						2	1	
CO3	2	2	1	1	1		1						2	1	
CO4	2	2	1	1	1		1						2	1	

Weightage: weak-01, moderate-02, strong-03

CH306TPC13 Chemical Reaction Engineering - II [L:3, T:1, P:0]

Objectives

1. To give fundamental knowledge on principles of non-ideal flow pattern and age distribution of chemical reaction systems
2. To understand the fluid-particle reaction and fluid-fluid reaction behaviour
3. To understand basic principles of catalyst and various catalyst synthesis methods
4. To understand the adsorption characteristics of catalyst.

Contents:

Unit-I: Basics of Non-Ideal Flow: Age distribution of fluid, the RTD, Conversion in nonideal flow reactors, Models for non-ideal flow- dispersion model, Chemical reaction and dispersion, Tank in series model.

Unit-II: Mixing of Fluids: Self mixing of single fluid, degree of segregation, Early and late mixing, Mixing of two miscible fluids.

Unit-III: Fluid Particle Reactions: Un-reacted core model: Diffusion through gas film and ash layer control, Chemical reaction control, Rate of reaction for shrinking spherical particles, Determination of rate controlling step.

Unit-IV: Fluid-Fluid Reactions: Kinetic regimes for mass transfer and reaction, Rate equations for various regimes, Film conversion parameter, Application to design, Reactive and extractive reactions.

Unit-V: Catalysis: Heterogeneous catalysts, Adsorption on solid surface, Physical properties of catalysts, Preparation of catalyst, Steps in catalytic reactions synthesizing the rate law.

Suggested Text Books :

1. Chemical Engineering Kinetics by .M. Smith
2. Chemical Reaction Engineering by Octave Levenspiel
3. Chemical Reaction Engineering by H. Scott Fogler
4. Principles of Reaction Engineering by S.D. Dawande, Central Techno Publications
5. Chemical Engineering by J. M. Coulson and Richardson, Volume IV.

Course Outcome:

Students would be able to

1. Understand the principles of non-ideal flow pattern and RTD
2. Determine the behaviour of fluid-particle and fluid-fluid reaction system
3. Synthesis of catalyst with various methods
4. Basics of adsorption characteristics of catalyst.

CO-PO Mapping															
CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	3	2							3	2	
CO2	3	3	2	2	2	2							3	2	
CO3	3	2	3	2	3	2							3	2	
CO4	2	1	2	2	2	1							3	2	
Weightage: weak-01, moderate-02, strong-03															

CH306TPE31 Organic Chemical Technology [L:3, T:0, P:0]

Objectives

To study process technologies of various organic process industries such as oil, soap, polymer and cellulose.

Contents:

Unit-I: Oils & Fats : Status and scope, Major oils seeds production in India, Expression, Solvent extraction, Energy & solvent requirements, Mineral, seeds and other oil bearing materials, Hydrogenation of oils, Corrosion problems and materials of construction of equipments.

Unit-II: Soaps & Detergents: Raw materials, Manufacture of detergents, Active detergent matter, Biodegradability, Fat splitting, Purification of fatty acids, Soap manufacture, Total fatty matters (TFM), Glycerin manufacture, Materials of construction.

Unit-III: Cane Sugar: Cane production & varieties, Manufacturing equipment &technology, Cane sugar refining, Bagasses utilization, Energy requirements and conservation, Environmental considerations, Khandsari technology, Molasses based industries, Materials of construction.

Unit-IV: Polymers: Status and scope, Applications, Classification of polymers, Degree and modes of polymerization, Molecular weight and it distribution, Selected industrial polymerization including plastics, Synthetic rubber and polymeric foams, Synthetic fibres. Penicillin: Manufacturing process, Scope and applications.

Unit-V: Regenerated Cellulose: Growth of industry, Raw materials, Pretreatment, Pulping, Manufacture of paper, Recovery of chemicals, Environmental considerations, viscose rayon.
Varnishes and Paints: Scope and applications, Types of coatings, General manufacturing procedure, Environmental considerations.

Suggested Text Books :

1. Shreve's Chemical Process Industries by G. T. Austin, Tata McGraw Hill Publications.
2. Dryden's Outlines of Chemical Technology by M. G. Rao and M. Sittig, East-West Press.

Reference Book:

1. Handbook of Oil & Colour, Chemists Association OCCA.

Course Outcome:

Students would be able to

1. Impart the basic concepts of chemical technology.
2. Develop understanding about unit process and unit operations in various industries.
3. Describe the processes involved in manufacturing of various organic chemicals and various chemical reactions involved in the process.
4. Draw the process flow diagrams and understand the major engineering problems encountered in the processes.
5. Explain important process parameters such as raw materials, environmental considerations, MOC, etc.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	3	3	3	3		1	3	3	3	1
CO2	3	2	1	2	2	1	3	3	2			1	2	2	1
CO3	3	2	3	2	2	1	2	1		1	1	2	3	2	1
CO4	3	2	1			1		1				1	2	2	
CO5	3	2	3	2	2	1	2			1	1	2	3	2	1

Weightage: weak-01, moderate-02, strong-03

CH306TPE32 Fuel Combustion Energy Technology [L:3, T:0, P:0]

Objectives

To understand the basics of various types of solid, liquid and gaseous fuels, basic principles of their combustion processes, its appliances, the fundamentals of the applied sciences dealing with various types of conventional and non-conventional energy resources.

Contents:

Unit-I: Solid Fuel : Classification of fuel, Origin, Composition, Characteristics and analysis of coal washing & storage of coal, Physical & chemical processing of coal, Various classification systems of coal briquetting, Carbonization, Gasification of coal. Liquid fuels: Origin, composition, characteristics and classification of crude oil, crude oil processing cracking and reforming, storage and handling of liquid fuel.
Gaseous fuel: Classification of gaseous fuel, Natural gas, Coal gas, Coke oven and blast furnace gas, producer gas, water and Carburetted water gas

Unit-II: Fuel Combustion Calculation: Fundamentals of various combustion calculations with numerical examples.

Unit-III: Combustion Process: General Principles of combustion, Flame, Draught, Limits of In flammability, Types of combustion Process- Surface, Submerged, Pulsating, Slow combustion.

Unit-IV: Energy Conservation: Energy consumption pattern in various sectors, various ways of energy conservation in various process industries including petroleum.

Unit-V: Non – Conventional Energy Technologies : General principles with applications and technology of Biomass Energy, Solar Energy, Geothermal Energy, Wind Energy, Nuclear Energy, Hydal, Tidal and Ocean Energy.

Suggested Text Books :

1. Elements of Fuel Combustion & Energy Engineering by S.N. Saha, Dhanpat Rai Publication Co. Pvt. Ltd. New Delhi.
2. Fuels and Combustion by S. Sarkar, Orient Longman, Hyderabad.

Course Outcome:
Students would be able to

1. Analyze solid, liquid, gaseous fuels and their characterization.
2. Compute fuel combustion calculation in industries with recommendation of better combustion processes in relation to better efficiency and pollution control technologies.
3. Study and recommend the various energy conservation routes in various industries.
4. Study and recommend the alternative sources of energies including the renewable energies in view of energy conservation to utilize them effectively.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	--	3	--	3	--	--	--	--	3	3	3	--
CO2	3	3	3	--	3	--	3	--	--	--	--	3	3	3	--
CO3	3	3	3	--	3	--	3	--	--	--	--	3	3	3	--
CO4	3	3	3	--	3	--	3	--	--	--	--	3	3	3	--

Weightage: weak-01, moderate-02, strong-03

CH306TMC02 Essence of Indian Knowledge Tradition [L:3, T:0, P:0]

Objectives:

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
- Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
- The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

Content:

- Basic structure of Indian Knowledge System, Introduction to traditional knowledge, definition of traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics.
- Modern Science and Indian Knowledge System.
- Traditional knowledge in different sectors; Traditional knowledge and engineering, Traditional medicine system, TK in agriculture.
- Protection of traditional knowledge, the need for protecting traditional knowledge significance of TK Protection, legal framework and TK; the scheduled tribes and other traditional forest dwellers (Recognition of Forest Rights) Act, 2006, plant varieties protection and farmer's rights act, 2001 (PPVFR Act); the biological diversity act 2002 and rules 2004, the protection of traditional knowledge bill, 2016

Suggested Text/Reference Books

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Fritzof Capra, Tao of Physics
4. Fritzof Capra, The wave of Life
5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta
7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016
8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016
9. P R Sharma (English translation), Shodashang Hridayam

Course Outcomes:

1. Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1						1	2								1
Weightage: weak-01, moderate-02, strong-03															

CH306TOE01 Industrial Utilities and Safety [L:3, T:0, P:0]

Objectives

To understand the basic knowledge about various process utilities applied in the chemical process industry and problems related to hazards & safety.

Contents:

Unit-I: Introduction: Role and types of process utilities in process industries. Heat Transfer Media: Characteristics properties, Classification, Selection and their industrial application.

Unit-II: Steam System: Generation and application in chemical process plants, Design of efficient steam heating systems, Condensate utilization, Flash steam. Steam Traps: Types and characteristics.

Unit-III: Water: Characteristic and conditioning for process industries e.g., steam piping, boiler feed, cooling etc., Recycling of process water.

Unit-IV: Introduction to process safety: Accidents and loss statistics, Nature of the accidents / hazardous process.
Toxicology: Toxic material and biological response, Dose responses relationship and models, Threshold dose and its definition, Material safety data sheets and industrial hygiene evaluation.
Safety Devices: Personal safety devices and general hygiene management, Storage and ventilation.

Unit-V: Fire and Explosion: Definition, Flammability characteristics and explosion, Design to prevent fires and explosions by inverting, purring, ventilation, sprinkler systems, Static electricity controls, Relief and relief sizing in vapour/gas, Liquid and runway reaction services.

Suggested Text Books :

1. High Temperature Heat Carrier by A. V. Chechetckin, Pergammon Press.
2. Efficient use of Steam by P. M. Goodal, Guilford
3. Chemical Process Safety: Fundamentals with applications by A. Crowl Daniel and F.L.Joseph, PHI Publications.

Reference Book:

1. Handbook of Heat Transfer Media by P. L. Geiringer, Van Nostrand Reinhold Inc.,U.S.

Course Outcome:

Students would be able to

1. Evaluate the requirements of process utilities in process industries.
2. Calculate the steam requirement and its applications as utility.
3. Explain fire and explosion and its prevention methods.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1									2	1	
CO2	2	2	1	1									2	1	
CO3	2	1	1	1									2	1	

Weightage: weak-01, moderate-02, strong-03

CH306PPC07 Mass Transfer Lab [L:0, T:0, P:3]

Objectives

To provide the knowledge of working of mass transfer equipment's and the application of mass transfer operations.

Contents:

1. Determination of diffusion coefficient of organic vapour in air.
2. Determination of the vapour liquid equilibrium (VLE).
3. Study of the characteristics of steam distillation.
4. To Verify Rayleigh equation for distillation.
5. Determination of absorption of CO, in a packed column.
6. Study of the solid-liquid extraction method.
7. Study of the liquid-liquid extraction method.

Study of the operation of fluidized bed dryer.

Course Outcome:

Students would be able to

1. Handle the mass transfer equipment's.
2. Understand molecular diffusion and Apply mass transfer operations for separation of mixture.

CO-PO Mapping															
CO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2		1			1		1				2	1	
CO2	2	2		1			1		1				2	1	
Weightage: weak-01, moderate-02, strong-03															

CH306PPC08 Process Dynamics and Control Lab [L:0, T:0, P:3]

Objectives:

Students will learn about the fundamental concepts, difficulties, methodologies, and applications of process control in order to govern a variety of processes.

Contents:

Introduction: A historical point of view Process control incentives, control system synthesis Process variables are classified and defined.

Mathematical Modeling & Experiments: Mathematical modelling is required and used. Parameters that are lumped and distributed Analogies, chemical and electrical systems. Determine the transfer function of non-interacting tank control, find the transfer function of liquid level control system, determine the nature U-tube manometer and determine transfer function of mercury glass thermometer.

Realization of Control Modes: Realization of different control modes like P, I, D, In electric, pneumatic, hydraulic controllers.

Laboratory Work: Simulation of different control modes and Experiments around Basic Process RIG.

Course Outcome:

Students will be able to

1. Demonstrate a fundamental understanding of process control after completing the course.
2. Create a mathematical model of a variety of chemical reactions.
3. Describe the various control modes and how they are used to control various operations.
4. Describe how electric, hydraulic, and pneumatic controllers function.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2		1			1		1				2	1	
CO2	2	2		1			1		1				2	1	
CO3	2	2		1			1		1				2	1	
CO4	2	2		1			1		1				2	1	

Weightage: weak-01, moderate-02, strong-03

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (Effective from Session 2021-22)

B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

FINAL YEAR, SEVENTH SEMESTER (AICTE)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
	THEORY					Sessional			
			L	T	P	IA	ESE	TOTAL	
01.	CH07TPC14	Process Equipment Design - II	3	1	0	30	70	100	4
02.	CH07TPC15	Chemical Reaction Engineering - II	3	1	0	30	70	100	4
03.	CH07TPC16	Transport Phenomena	3	1	0	30	70	100	4
04.	CH07TPE4X		3	0	0	30	70	100	3
05.	CH07TOE3X		3	0	0	30	70	100	3
	PRACTICAL								
01.	CH07PPC11	Minor Project	0	0	3	30	20	50	1.5
02.	CH07PPC12	Seminar	0	0	3	30	20	50	1.5
		Total	15	3	6			600	21

IA – Internal Assessment
Total Marks – 600

ESE - End Semester Examination
Total Periods / week - 24

Total Credits : 21

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (Effective from Session 2021-22)

B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

FINAL YEAR, EIGHTH SEMESTER (AICTE)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
	THEORY					Sessional			
			L	T	P	IA	ESE	TOTAL	
01.	CH08TPC17	Process Equipment Design - III	3	1	0	30	70	100	4
02.	CH08TPE5X		3	0	0	30	70	100	3
03.	CH08TOE4X		3	0	0	30	70	100	3
	PRACTICAL								
01.	CH08PPC13	Project	0	0	8	70	30	100	4
		Total	9	1	8			400	14

IA – Internal Assessment

ESE - End Semester Examination

Total Credits : 14

Total Marks – 400

Total Periods / week - 18

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

DEPARTMENT OF CHEMICAL ENGINEERING

List of Professional Elective Courses (Seventh and Eighth semester) (AICTE)

S. No.	Semester	Course No.	Subject
01.	VII	CH07TPE41	Petroleum Refinery Engineering
02.		CH07TPE42	Polymer Technology-I
03.		CH07TPE43	New Separation Processes
04.	VIII	CH08TPE51	Petrochemical Technology
05.		CH08TPE52	Polymer Technology-II
06.		CH08TPE53	Design and Development of Catalyst

List of Open Elective Courses (Seventh and Eighth semester) (AICTE)

S. No.	Semester	Course No.	Subject
01.	VII	CH07TOE31	Process Modelling & Simulation
02.		CH07TOE32	Water Conservation & Management
03.	VIII	CH08TOE41	Optimization Techniques
04.		CH08TOE42	Project Engineering Economics & Management

Program Outcomes	
PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering comm Modules and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Program Specific Outcomes	
PSO1	The students of the programme will have a strong foundation in mathematics, basic sciences and chemical engineering to meet the current demands in professional world with cutting-edge research in chemical and allied engineering disciplines.
PSO2	Graduates would be equipped with a working knowledge in professional courses such as process economics, project engineering, industrial safety and sustainable development to work in the conventional as well as frontier area of Chemical Engineering which enables them suitable for chemical industries.
PSO3	Graduates of chemical engineering will be able to communicate in a professional setting, including soft skills, technical writing, presentation, and management skills making them employable to industries.

B.Tech. VII Semester

CH07TPC14 Process Equipment Design - II [L:3, T:1, P:0]

Objectives

This course enables students to integrate all the subjects that they have learnt and design plant/processes from Chemical Engineering Principles. Graduates shall be able to: (a) Understand the Chemical Engineering Principles applicable to design Chemical Engineering equipment's; (b) apply standard codes for design of chemical plant equipment; (c) analyse the specifications for process equipment; (d) design process equipment's and its accessories.

Contents

Design of Heat Transfer Equipment's: Double Pipe Heat Exchanger, Shell and Tube Heat Exchanger, Vertical & Horizontal Condensers and Evaporators.

The candidates will be allowed to use the following reference book in the examination hall:

1. Hand book of Chemical Engineering J. H. Perry
2. Tubular Heat Exchange Manufacture Association Manual
3. Process Heat Transfer by D.Q. Kern
3. ISI Codes.

Candidates have to bring their own copies of the above books and they will be not supplied by the university or the examination centers.

Suggested Text Books

1. Process Heat Transfer by D. Q. Kern
2. Heat Transmission by McAdams
3. Unit Operations of Chemical Engineering by McCabe Warren, L Smith Julian and Harriot Peter, Fifth Edition, McGraw Hill Inc.
4. Chemical Engineering by J. M. Coulson and Richardson, Volume-1

Course Outcomes

Students should be able to

1. Design, calculate size/power/internals, etc required for all the process equipment in the PFD together with necessary instrumentation, safety aspects.
2. Calculate costs of equipment.
3. Perform a techno economic feasibility of the selected process.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2			1						3	2	
CO2	3	3	2	2			1						3	2	
CO3	3	3	2	2			1						3	2	

Weightage: weak-01, moderate-02, strong-03

CH07TPC15 Chemical Reaction Engineering – II [L:3, T:1, P:0]

Objectives

Graduates shall be able to (a) understand fundamental principles and experimental techniques of heterogeneous reaction systems; (b) apply principles of transfer operation in kinetics studies of heterogeneous reaction systems; (c) analyze the rate controlling step in heterogeneous reaction systems; (d) evaluate the catalytic activity and selectivity influenced by the physical and surface properties of the catalyst.

Contents

Unit-I : Basics of Non-Ideal Flow: Age distribution of fluid, the RTD, Conversion in nonideal flow reactors, Models for non-ideal flow- dispersion model, Chemical reaction and dispersion, Tank in series model.

Unit-II : Mixing of Fluids: Self mixing of single fluid, degree of segregation, Early and late mixing, Mixing of two miscible fluids.

Unit-III : Fluid Particle Reactions: Un-reacted core model: Diffusion through gas film and ash layer control, Chemical reaction control, Rate of reaction for shrinking spherical particles, Determination of rate controlling step.

Unit-IV : Fluid-Fluid Reactions: Kinetic regimes for mass transfer and reaction, Rate equations for various regimes, Film conversion parameter, Application to design, Reactive and extractive reactions.

Unit-V : Catalysis: Heterogeneous catalysts, General characteristics, Adsorption on solid surface, Physical properties of catalysts, Preparation of catalyst, Steps in catalytic reactions, synthesizing the rate law.

Suggested Text Books

1. Chemical Engineering Kinetics by J.M. Smith
2. Chemical Reaction Engineering by Octave Levenspiel
3. Chemical Reaction Engineering by H. Scott Fogler
4. Principles of Reaction Engineering by S.D. Dawande, Central Techno Publications
5. Chemical Engineering by J. M. Coulson and Richardson, Volume IV.

Course Outcomes

Students would be able to

1. Explain the concepts of reactor design and reaction kinetics.
2. Interpret reactor data.
3. Identify ideal reactors and explain various aspects of design for single reactions.
4. Explain various aspects of design for multiple reactions.
5. Analyze effects of temperature and pressure on conversion.

CO-PO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	2	2	3	2							3	2	
CO2	3	3	2	2	2	2							3	2	
CO3	3	2	3	2	3	2							3	2	
CO4	2	1	2	2	2	1							3	2	
CO5	3	2	1	2	2	1							3	2	

Weightage: 1-Slightly; 2-Moderate; 3-Strongly

CH07TPC16 Transport Phenomena [L:3, T:1, P:0]

Objectives

To impart knowledge about individual and simultaneous momentum, heat and mass transfer, model development along with appropriate boundary conditions.

Contents

Unit-I: Introduction to Transport Phenomena: Similarity between momentum, heat and mass transfer, The continuum hypothesis, Basic laws of fluid motion, Newton's second law of motion, Principle of balance between momentum, Heat and mass transfer, Principles of conservation of momentum, mass and energy.

Unit-II: Momentum Transport Phenomena: Momentum transport in laminar flow: Newton's law of viscosity, Science of rheology, Prediction of viscosity and its dependence on temperature, pressure and composition, Boundary conditions, Shell balance approach for stress distribution and velocity profiles, Introduction to time derivatives and vector analysis, Equation of continuity and equation of motion and their application in fluid flow problems.

Unit-III: Unsteady State Momentum Transport: Flow near a wall suddenly set in motion, Momentum transport phenomena in turbulent flow, Definitions of friction factors, friction factor for flow in tubes, around spheres and through packed bed column.

Unit-IV: Energy Transport Phenomena: Energy transport in laminar flow: Fourier's law of heat conduction, Prediction of thermal conductivities and its dependence on temperature, Pressure and composition, Boundary conditions, Shell balance approach, Types of heat sources, Principle of extended surfaces, Types of cooling fans, Free and forced convection. Unsteady state heat transport, Unsteady state heat conduction in solids, Heating of semi-infinite slab, Heating of finite slab, Application.

Unit-V: Mass Transport Phenomena: Definitions of concentration, Velocities and mass fluxes, Fick's law of diffusion, Prediction of diffusivity and its dependence on temperature, pressure and composition, Boundary conditions, Shell balance approach for mass transfer problems. Problems of diffusion with homogeneous and heterogeneous chemical reaction, Diffusion and chemical reaction in porous catalyst the effectiveness factor, Equation of continuity for multicomponent mixtures.

Suggested Text Books

1. Transport Phenomena by R.B. Bird, W.E. Stewart and E. W. Lighfoot, John Wiley & Sons
2. Transport Phenomena by R. S. Brodkey and H. C. Hershey, McGraw-Hill
3. Fundamentals of Momentum Heat and Mass Transfer by J.R. Welty, C.W. Wicks, R.E. Wilson and G. Rorrer, John Wiley & Sons.

Course Outcomes

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

1. analyze heat, mass, and momentum transport in a process;
2. formulate problems along with appropriate boundary conditions;
3. develop steady and transient solution for problems involving heat, mass, and momentum transport.

CO-PO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	2	2	3	2							3	2	
CO2	3	3	2	2	2	2							3	2	
CO3	3	2	3	2	3	2							3	2	

Weightage: 1-Slightly; 2-Moderate; 3-Strongly

CH07TPE41 Petroleum Refinery Engineering [L:3, T:0, P:0]

Objectives

To impart knowledge of petroleum refining, hydrocarbon processing, and derived petrochemicals.

Contents

Unit-I: Petroleum Crude and Refining: Formation of petroleum crude, Origin & occurrence composition, Classification & physical properties of petroleum crude, Conversion of organic matter into petroleum crude, Different sources of petroleum oil, refining of petroleum crude, Type of refineries, Planning for operation of oil refinery.

Unit-II: Physical Properties and Testing Methods of Petroleum Products: Physico-chemical properties of various petroleum products as per API / ASTM / BIS specifications.

Unit-III: Crude Processing: Treatment of crude, atmospheric and vacuum distillation crude, Distillation & equilibrium, Degree of separation, Type of trays of distillation column & its efficiencies, Types of distillation in petroleum industries.

Unit-IV: Cracking & Reforming Operation: Cracking, Type of cracking, Thermal cracking reaction, Dubbs process & tube still process of thermal cracking, Vis breaking, Delayed coking & fluidized coking, Catalytic cracking, Fixed & moving bed catalytic cracking, Thermal reforming, Catalytic reforming processes.

Unit-V: Chemical Treatment & Refining Operation: Chemical treatment of petroleum products, Caustic soda treatment, Treatment with H_2SO_4 & H_2, Mercaptan removal & oxidation process, Sulphur removal from petroleum products-Doctor's treatment, hydro de-sulphurization, dewaxing and refining of lubricating oils.

Suggested Text Books

1. Petroleum Refinery Engineering by W.L. Nelson
2. Petroleum Refining by Gary and Handwarke, Marcel Dekker
3. Petroleum Refining & Petrochemicals by N.K. Sinha, Umesh Publications New Delhi.
4. Petroleum Refining Technology by I.D. Mall, CBS Publishers & Distributors Pvt. Ltd. New Delhi.

Course Outcomes

Students would be able to

1. explain petroleum refining and thermal cracking processes;
2. detail catalytic cracking and catalytic reforming processes;
3. produce fuels such as aviation gasoline, motor fuel, kerosene, jet fuel;
4. manufacture lubricating oil;
5. store and transport petroleum products.

CO-PO Mapping															
CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	1	1				1						2	2	
CO2	1	1	1				1						2	2	
CO3	1	1	1				1						2	2	
CO4	1	1	1				1						2	2	
CO5	1	1	1				1						2	2	
Weightage: 1-Slightly; 2-Moderate; 3-Strongly															

CH07TPE42 Polymer Technology - I [L:3, T:0, P:0]

Objectives

To deal with identification and characterization of raw material for ensuring the quality of polymer product along with different techniques of processing. 2. To develop the skills required for working in production, processing, testing, marketing and sales department of plastics, rubbers and fibres manufacturing Industries.

Contents

Unit-I: Introduction to Polymer Science: Classification of polymer and functionality, Polymerization, Polymer structure, Molecular weight distribution, Number average, Weight average, z-average Molecular weight, Chemical structure and thermal transition types, Mechanism of polymerization.

Unit-II: Polymer Synthesis: Step growth polymerization and its kinetics, Molecular weight of step growth polymerization, Chain growth polymerization and its kinetics, Copolymerization and its kinetics, Polymerization techniques, Reaction of synthetic Polymer, Chemical structure determination.

Unit-III: Conformation, Solution and Molecular Weight: Thermodynamics of polymer solution, Flory Huggins theory, Polymer conformation and chain dimensions, Process of polymer dissolution, Nature of polymer molecules in solution, Measurement of molecular weight, Osmometry, Light scattering, GPC, Viscosity of dilute polymer solution.

Unit-IV: Solid State Properties: Amorphous state, Glass transition temperature, Glassy solid and glass transition, The crystalline state, Crystal melting temperature, Degree of crystallinity & its effect on properties of polymer, Mechanical properties and methods of its testing.

Unit-V: Polymer Degradation & the Environmental Effect: Polymer degradation and stability, Types of degradation, Thermal degradation, Mechanical degradation, Photo degradation, Degradation by high energy radiation, Hydraulic degradation, The management of plastic in environment, biodegradation.

Suggested Text Books

1. Polymer Science and Technology by Fried
2. Outlines of Polymer Technology by Sinha, PHI
3. Polymer Science by V.R. Gowariker, New age International Ltd

Course Outcomes

Students would be able to

1. select appropriate techniques of polymerization;
2. produce plastics using appropriate reactions and unit operations steps;
3. produce rubbers using appropriate reactions and unit operations steps;
4. produce fibres using appropriate reactions and unit operations steps;
5. apply different polymer processing techniques.

CO-PO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	1				1						2	2	
CO2	1	1	1				1						2	2	
CO3	1	1	1				1						2	2	
CO4	1	1	1				1						2	2	
CO5	1	1	1				1						2	2	

Weightage: 1-Slightly; 2-Moderate; 3-Strongly

CH07TPE43 New Separation Processes [L:3, T:0, P:0]

Objectives

This is a course further built up on and in continuation with Chemical Engineering operations. It forms the basis Chemical Engineering principles and hence it is required in almost all the courses and throughout the professional career of a Chemical Engineer.

Contents

Unit-I: Overview of Separation Processes: Basic concepts of separation processes; Physico-chemical properties and other factors controlling separation; Limitations of Conventional separation processes and new separation processes; Equilibrium and rate governed separation processes and their characteristics.

Unit-II: Membrane based Separation Processes: Principle of membrane separations process, advantages and disadvantages; classification, membrane materials, general methods of preparation and characterization of membranes; Membrane modules, Concentration polarization.

Unit-III: Porous Membrane Based Processes: Reverse osmosis, Ultrafiltration, Microfiltration, Nano-filtration, Dialysis, Ion-selective membranes and electro-dialysis; Industrial applications of porous membrane-based processes.

Unit-IV: Non-porous Membrane Based Processes: Gas separation, Pervaporation, Liquid Membranes and their Industrial Applications, Medical Applications of Membranes, Miscellaneous Membrane Processes, Membrane Distillation, Membrane Reactors.

Unit-V: Other Non-conventional Separation Processes: Foam and Bubble Fractionation, Pressure and Temperature Swing Adsorption, Cloud Point Extraction, Centrifugal Separation Processes, Super Critical Fluid Extraction.

Suggested Text Books

1. Separation Process Principles by J.D. Seader and E.J. Henley, John Wiley & Sons, Inc
2. Separation Processes by C. J. King, McGraw-Hill, Inc.
3. Membrane Separation Processes by K. Nath, PHI, New Delhi
4. Membrane Technology and Applications by R.W. Baker, , John Wiley and Sons UK
5. Handbook of Industrial Membrane Technology by M.C. Porter, Crest Publishing House.

Course Outcomes

Students would be able to

1. Explain membrane processes in terms of the membrane, feed, sweep, retentate, permeate, and solute membrane interactions.
2. Distinguish among microfiltration, ultrafiltration, Nano filtration, virus filtration, sterile filtration, filter-aid filtration, and reverse osmosis in terms of average pore size.
3. Explain common idealized flow patterns in membrane modules.

CO-PO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	1				1						2	2	
CO2	1	1	1				1						2	2	
CO3	1	1	1				1						2	2	

Weightage: 1-Slightly; 2-Moderate; 3-Strongly

CH07TOE31 Process Modelling & Simulation [L:3, T:0, P:0]

Objectives

Graduates shall be able to (a) understand chemical engineering system in term of modelling principle; (b) distinguish simulation from design of equipment; (c) apply software tools such as UNISIM to model chemical processes; (d) develop algorithm for modelling & solve the model.

Contents

Unit-I: Introduction: Uses of Mathematical Models, Scope of Coverage, Principles of Formulations. Mathematical Modeling in Chemical Reaction Engineering: CSTR, PFR, Batch Reactor, Semi batch Reactor, Series of Isothermal CSTR, Constant Hold-Up CSTR's, CSTR's with Variable Hold Ups, Gas Phase Pressurized CSTR, Non-Isothermal CSTR, Bioreactor, Trickle Bed Reactor.

Unit-II: Mathematical Modeling in Mass Transfer: Ideal Binary Distillation Column, Multi-Component Non-ideal Distillation Column, Batch Distillation with Hold Up, Steam Distillation, Multi-Solute Batch Liquid- Liquid Extraction, Continuous Extraction, Multistage Countercurrent Extraction, Plug Flow Type Liquid- Liquid Extraction, Reactor with Mass Transfer, Absorption, Adsorption.

Unit-III: Mathematical Modeling in Heat Transfer: Two Heated Tanks, Single Component Vaporizer, Double Pipe Heat Exchanger, Shell and Tube Heat Exchanger, Multicomponent Flash Drum, Cooling Towers.

Unit-IV: Mathematical Modeling of Other Chemical Processes: Interacting and Non-Interacting Systems with and without Heaters, Isothermal Hydraulic System, Forward and Backward Feed Triple Effect Evaporator.

Unit-V: Introduction of MATLAB and Use of Language, Simulation, Program Development and Numerical Solutions of Above Processes.

Suggested Text Books

1. Process Modeling, Simulation and Control for Chemical Engineers by W. L. Luyben, McGraw Hill, 1990.
2. Process Plant Simulation by B. V. Babu, Oxford University Press, 2004.
3. Optimisation Techniques for Chemical Engineers by A. Hussain and K. Gangaiah, Macmillan, 2001.
4. Process Control: Modeling, Design and Simulation by B. W. Bequette. Prentice-Hail India, 2006.
5. Elements of Chemical Reaction Engineering by Fogler, Prentice Hall of India.

Course Outcomes

Students would be able to

1. explain detail importance of ODE and PDE;
2. develop model equations for the given system;
3. solve structural, thermal, fluid flow problems;
4. demonstrate the model solving ability for various processes/unit operations;
5. demonstrate the ability to use a process simulation.

CO-PO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
CO2	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
CO3	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
CO4	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
CO5	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--

Weightage: 1-Slightly; 2-Moderate; 3-Strongly

CH07TOE32 Water Conservation & Management [L:3, T:0, P:0]

Objectives

To introduce the water management principles related to process plants.

Contents

Introduction: water cycle, water storage, water quality; water conservation in homes; water conservation in the work place; water management-water quality, controlling use and quality of water, water flow measurement, water quality control, testing water salinity, preserving water quality, minimising evaporation, water sanitation, water audits; water conservation in agriculture; water conservation in process industry; water conservation in construction industry; water conservation in service industry.

Suggested Text Books

1. Water Conservation, Management and Analysis by V. Madireddi and Subba Rao, Read worthy Publications (Pvt) Ltd
2. Protection and Conservation of, Water Resources by Hadrian F. Cook, John Wiley & Sons Inc.
3. Water Resources, Conservation and Management by S.N. Chatterjee, Atlantic Publishers & Dist.

Course Outcomes

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

1. evaluate the performance of industrial boilers and furnaces;
2. identify the scope for recycle and reuse of water;
3. choose methods for waste minimization and water conservation.

CO-PO Mapping															
CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						2	2						1		
CO2						2	2						1		
CO3						2	2						1		
Weightage: 1-Slightly; 2-Moderate; 3-Strongly															

B.Tech. VIII Semester

CH08TPC17 Process Equipment Design- III [L:3, T:1, P:0]

Objectives

Chemical Engineers should have knowledge about Design of mass transfer Equipment such as absorption, Distillation Columns, dryer etc. This will also be useful for using Design software which is widely used in chemical industries.

Contents

Mass Transfer Equipment design of: Absorption tower, Distillation tower, Tunnel and rotary dryers.

Suggested Text Books

1. Hand Book of Chemical Engineering J. H. Perry
2. Coulson & Richardson Vol.- VI
3. Mass Transfer by R. E. Treybal
4. ISI Codes

Candidates have to bring their own copies of ISI Code book and they will be not be supplied by the university or the examination centres.

Course Outcomes

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

1. design mass transfer equipment's for chemical process.;
2. prepare drawing for chemical process equipment's.

CO-PO Mapping															
CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	1	1		1						2	1	1
CO2	2	2	2	1	1								2	1	1
Weightage: 1-Slightly; 2-Moderate; 3-Strongly															

CH08TPE51 Petrochemical Technology [L:3, T:0, P:0]

Objectives

To impart knowledge of petroleum refining, hydrocarbon processing, and derived petrochemicals.

Contents

Unit-I: Survey of Petrochemical Industries: Petrochemical industries in India, Plastic and synthetic fiber industries, Product of petroleum industries, Feed stocks for petrochemical production, Purification and separation of feed stocks.

Unit-II: C1 and C2 Hydrocarbons: Chemicals from methane, ethane, ethylene and acetylene, Synthesis gas as a feed stock for chemical industries, Naphtha cracking and reforming, Hydrogen from reforming of hydrocarbons.

Unit-III: Chemicals from C3, C4 and Higher Fractions: Carbon compound, Dehydrogenation of hydrocarbon and higher paraffins, Greases and lubricants, Polymers and their properties, Polymers from olefins- polyethylene (HDPE, LDPE), Polypropylene, Vinyl polymers.

Unit-IV: Aromatic Hydrocarbons: Production of BTX, Benzene derivatives, Products from toluene, Oxidation products of toluene, Synthetic fibers and their production, Synthetic rubber and its production.

Unit-V: Plastics: Classifications of plastics, Different types of resin and their production, ABS plastics, Poly carbonates (PC), Poly urethanes, Polyimides, Polystyrene, Synthetic detergents and their production.

Suggested Text Books

1. Modern Petroleum Technology by G.D. Hobson and W Pow.
2. A Textbook on Petrochemical Technology by Bhaskara Rao.

Course Outcomes

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

1. select the appropriate characterization parameters;
2. specify the properties of petroleum products;
3. attain knowledge of various separation & conversion processes involved in petroleum refining;
4. attain knowledge of manufacturing of various petrochemical products.

CO-PO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	1				1						2	2	
CO2	1	1	1				1						2	2	
CO3	1	1	1				1						2	2	
CO4	1	1	1				1						2	2	

Weightage: 1-Slightly; 2-Moderate; 3-Strongly

CH08TPE52 Polymer Technology - II [L:3, T:0, P:0]

Objectives

(a) To deal with identification and characterization of raw material for ensuring the quality of polymer product along with different techniques of processing; (b) To develop the skills required for working in production, processing, testing, marketing and sales department of plastics, rubbers and fibres manufacturing Industries.

Contents

Unit-I: Additives, Blends & Composites: Additives, Plasticizers, Fillers & reinforcements, Stabilizers, Flame retardants, Biocides, Processing additives, Colorants, Polymer blends, Interpenetrating network, Introduction to polymer composites, Composite fabrication.

Unit-II: Polymer Reaction: Hydrolysis, Acidolysis, Aminolysis, Hydrogenation, Addition and substitution reaction, Reaction of various specific groups, Cross linking reaction, Reaction leading of graft & block copolymers, Miscellaneous reactions.

Unit-III: Experimental Methods: Polymer synthesis, Isolation and purification of polymers, Polymer fractionation, Molecular weight determination, Molecular weight distribution curve, Determination of glass transition temperature.

Unit-IV: Engineering and Specialty Polymers: Engineering thermoplastics, Polyolefins, Vinyl polymers, Polyamides, Polycarbonates, Polysulphone, Fluoropolymers, Inorganic polymers, Thermoplastic polyesters, Natural and synthetic rubber, Cellulose and its derivatives.

Unit-V : Polymer Processing & its Manufacturing: Basic processing operations, Extrusion, Modeling, Calendering, Coating, Injection moulding, Compression moulding, Transfer moulding, Blow moulding, Die casting, Rotation casting, Film casting.

Suggested Text Books

1. Polymer Science and Technology by Fried
2. Outlines of Polymer Technology by Sinha PHI
3. Polymer Science by V.R. Gowariker New age International Ltd.

Course Outcomes

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

1. select appropriate techniques of polymerization;
2. produce plastics using appropriate reactions and unit operations steps;
3. produce rubbers using appropriate reactions and unit operations steps;
4. produce fibres using appropriate reactions and unit operations steps;
5. apply different polymer processing techniques.

CO-PO Mapping															
CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	1	1				1						2	2	
CO2	1	1	1				1						2	2	
CO3	1	1	1				1						2	2	
CO4	1	1	1				1						2	2	
CO5	1	1	1				1						2	2	
Weightage: 1-Slightly; 2-Moderate; 3-Strongly															

CH08TPE53 Design and Development of Catalyst [L:3, T:0, P:0]

Objectives

To gain the knowledge of catalyst characteristics, mechanism of catalytic reactions, and design of catalytic reactors.

Contents

Structure of Solid Surfaces, Chemisorption and Physiosorption, Thermodynamics and Kinetics of Surface Processes, Principles of Heterogeneous Catalysis, Preparation, Characterization and Classification, Kinetics of Heterogeneous Reactions, Physical, Chemical and Mathematical Description of Catalyst Deactivation, Deactivation by Fouling, Poisoning and Sintering, Deactivation and Regeneration of Catalyst Pellets, Deactivation and Regeneration of Fixed Beds, Dynamics of Polyfunctional Catalysts, Electro catalysis and Photocatalyis, Mechanism and Kinetics of Some Typical Heterogeneous Catalytic Reactions, Applications in Fertilizer, Petroleum, Petrochemical Industries and Pollution Control.

Suggested Text Books

1. Preparation of Catalyst VI: Scientific bases for the preparation of Haterogeneous Catalysts by G. Poncelet,J. Martens, B. Delmon, Elseveir
2. Catalyst Preparation: Science and Engineering by John Regalbuto, CRC Press

Course Outcomes

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

1. (a) develop various catalytic reaction mechanisms;
2. characterize a catalyst;
3. assess the effects of external heat and mass transfer effects in heterogeneous catalysis;
4. calculate the effectiveness of a porous catalyst;
5. design different types of reactors for catalytic reactions.

CO-PO Mapping															
CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	1	1				1						2	2	
CO2	1	2	1				1						2	2	
CO3	1	1	1				1						2	2	
CO4	2	1	1				1						2	2	
CO5	1	1	1				1						2	2	
Weightage: 1-Slightly; 2-Moderate; 3-Strongly															

CH08TOE41 Optimization Techniques [L:3, T:0, P:0]

Objectives

To study and apply optimization techniques in the chemical process industry.

Contents

Unit-I: System Analysis and Modelling: Introduction to systems analysis and modelling with reference to chemical engineering problems, Differential method for solving one and two variable problems with and without constraints, Case studies, Application of langrangian multiplier method.

Unit-II: Linear Programming: Modelling, graphical method, single phase simplex method, two phase simplex method, duality, sensitivity analysis.

Unit-III: Geometric Programming: As applied to chemical engineering problems with degree of difficulty equal to zero and one, with and without constraints.

Unit-IV: Search Methods: Sequential search methods - Golden section method, dichotomous search method, Interval halving method, Fibonacci method.

Unit-V: Dynamic Programming: Introduction to dynamic programming as applied to discrete multistage problems like cascade of CSTR, Train of heat exchanger etc., Computer programming techniques applied to optimization.

Suggested Text Books

1. Optimization Theory and Practice by Beveridge and Schecheter
2. Optimization Techniques for chemical Engineers by Asghar Hussain
3. Optimization by S.S. Rao
4. Linear Programming by Hadley

Course Outcomes

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

(a) formulate the objective functions for constrained and unconstrained optimization problems;

(b) use different optimization strategies;

(c) Solve problems using non-traditional optimization techniques;

(d) use of different optimization techniques for problem solving.

CO-PO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	2	1								2	2	2
CO2	1	2	1	2	2								1	2	2
CO3	2	2	3	2	2								2	2	1
CO4	2	2	2	2	2								2	2	2

Weightage: 1-Slightly; 2-Moderate; 3-Strongly

CH08TOE42 Project Engineering, Economics & Management [L:3, T:0, P:0]

Objectives

This course is required for the future professional career for engineering related industrial economics and management.

Contents

Unit I: Nature and Importance of Project and Project Engineering: Concept of Project and Project Management, Characteristics of Project, Introduction to Project Engineering, Role of a Project Leader, General Design Considerations, Plant Layout and Site Selection, Flow Diagram, Concept of Scale Up, Concepts of Techno-Economic Feasibility Report.

Unit II: Technical and Financial Analysis: Technical Analysis, Financial Analysis, Significance of Financial Analysis, Elementary knowledge of book of accounts- Journal, Ledger, Balance sheet, Profit and Loss Account. Cost Estimation, Cash Flow Investment, Production Cost, Capital Investment, Cost Indices, Production and Overhead Cost, Interest and Taxes.

Unit III: Project Financing and Value Engineering: Meaning and Importance of Project Finance, Means of Finance and Sources of Project in India, Financial Institution Structure and Financial Assistance, Norms of Finance and Term Loan Procedure, Value Engineering – Function, Aims and Procedure.

Unit IV: Capital Expenditure, Profitability & Alternative Investments: Importance and Kinds of Capital Expenditure Decision, Capital Budgeting Process, Criteria of Capital Budgeting, Depreciation and its Calculation Methods, Methods of calculating profitability, Alternative investments, Break Even Analysis.

Unit V: Network Techniques For Project Management: Introduction, Development of Project Network, Network Scheduling, Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of Activity Networks, Time Analysis, Gantt Chart.

Suggested Text Books

1. Plant Design & Economics for chemical Engineers by M.S. Peters & K. D. Timmerhaus.
2. Projects: Planning, Analysis, Selection, Financing, Implementation and Review by Prasanna Chandra.
3. Project Engineering of Process Plants by H. F. Rase
4. Pilot Plants and Models and Scale up Methods in Chemical Engineering by R. E. Johnston.

Course Outcomes

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

1. select a site for the project from given alternatives,
2. calculate working capital requirement for a given project,
3. calculate cost of equipment used in a plant total project cost,
4. calculate cash flow from a given project and understand the break-even analysis;
5. calculate depreciation and list out various milestones related to project concept to commissioning.

CO-PO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		1	1	1	1						2		2	1	
CO2	2	1	1	1	1						2		2	1	
CO3	2	1	1	1	1						2		2	1	
CO4	2	1	1	1	1						2		2	1	
CO5	2	1	1	1	1						2		2	1	

Weightage: 1-Slightly; 2-Moderate; 3-Strongly