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

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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 OUTCOMES:

At the end of the course the students will be able to:

1. Analyze and apply measures of location and measures of dispersion grouped and ungrouped series.
2. Apply discrete and continuous probability distributions to various business problems.
3. Perform test of hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases andlearn the concept of p–values.
4. Learn non–parametric test such as the Chi–square test for independence as well as goodness of fit.
5. To enable the students to analyze data and draw appropriate statistical conclusions.

CO-PO Mapping

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

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.

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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															