



**List of Courses Focus on Employability/ Entrepreneurship/
Skill Development**

Department : Chemical Engineering

Programme Name : B.Tech.

Academic Year : 2017-18

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	MEBTES04	Engineering Thermodynamics
02.	MEBLES06	Workshop Practice
03.	CH3TES05	Fluid Mechanics
04.	CH3PES05	Fluid Mechanics Lab
05.	CH3TPC02	Chemical Engineering Calculation
06.	CH3TES06	Chemical Engineering Thermodynamics-I
07.	CH4TBS06	Numerical Analysis & Computer Applications
08.	CH4PBS03	Numerical Analysis & Computer Applications Lab
09.	CH4TPC03	Inorganic Chemical Technology
10.	CH4TPC04	Mechanical Operations
11.	CH4PPC02	Mechanical Operations Lab
12.	CH4TPC05	Process Instrumentation
13.	CH4THS05	Business Communication And Presentation Skill
14.	CH5TPC06	Heat Transfer
15.	CH5PPC03	Heat Transfer Lab
16.	CH5TPC07	Mass Transfer-I
17.	CH5PPC04	Mass Transfer-I Lab
18.	CH5TPC08	Chemical Reaction Engineering-I
19.	CH6TPC10	Process Dynamics And Control
20.	CH6PPC07	Process Dynamics & Control Lab
21.	CH5PPC05	Chemical Reaction Engineering Lab
22.	CH5TPE13	Food Engineering
23.	CH6TPE31	Fertilizer Technology
24.	CH6TPC09	Mass Transfer-II
25.	CH6TPE31	Fuel Combustion & Energy Technology
26.	CH6TPE21	Process Equipment Design-I



27.	CH6TPC11	Organic Chemical Technology
28.	CH6PPC07	Mass Transfer-II Lab
29.	CH4702	Process Equipment Design-II
30.	CH4703	New Separation Processes
31.	CH4707	Computer Aided Design & Simulation
32.	CH4709	Minor Project
33.	CH3604	Chemical Reaction Engineering-II
34.	CH4708	Vocational Training Viva Cum Seminar
35.	CH4701	Project Engineering, Economics And Management
36.	CH4803	Environmental Pollution Control Engineering
37.	CH4807	Major Project
38.	CH4705	Petroleum Refinery Engineering
39.	CH4806	Petrochemical Engineering
40.	CH4801	Optimization Techniques In Chemical Engineering
41.	CHPG1101	Advanced Heat Transfer
42.	CHPG1102	Chemical Reactor Design
43.	CHPG1103	Fluidization Engineering
44.	CHPG1105	Membrane Separation Processes
45.	CHPG1106	Chemical Engineering Computational Lab
46.	CHPG1201	Advanced Fluid Mechanics
47.	CHPG1202	Advanced Mass Transfer
48.	CHPG1203	Industrial Pollution Control Technologies
49.	CHPG1204	Design And Development Of Catalyst
50.	CHPG1206	Project
51.	CHPG1207	Seminar



Scheme and Syllabus

SCHEME OF EXAMINATION B.Tech - I Year (2nd Sem.), Common to All Branches, Course - B,

w.e.f. Session: 2015- 2016

S. No	Subject Code	Subjects Theory	Periods /Week			Evaluation Scheme					Grand Total	Credits	
			L ¹	T ²	P ³	Internal Assessment				E.S.E			
						C.T. ⁵	M.S.E. ⁴	T.A. ⁷	L.A. ⁶				Total
1	CHBTHS02	Environmental Studies	3	0	0	10	20	10	-	40	60	100	3
2	MEBTES04	Engineering Thermodynamics	3	1	0	10	20	10	-	40	60	100	4
3	EEBTES05	Basic Electrical & Electronics Engineering	3	1	0	10	20	10	-	40	60	100	4
4	PHBTBS03	Engineering Physics	3	0	0	10	20	10	-	40	60	100	3
5	EMBTBS04	Engineering Mathematics - II	3	0	0	10	20	10	-	40	60	100	3
Practical													
1	EEBLES05	Basic Electrical & Electronics Engg. Lab	0	0	3	-	-	-	30	30	20	50	2
2	PHBLS03	Engineering Physics Lab	0	0	3	-	-	-	30	30	20	50	2
3	MEBLES06	Workshop Practice	0	0	3	-	-	-	30	30	20	50	2
Total Credits											23		

¹-Lecture Hours, ²-Tutorial Hours, ³- Practical Hours, ⁴- Mid Sem. Exam, ⁵-Class Tests/Assignments, ⁶-Lab Work Assessment, * - Mandatory course

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

**SCHEME FOR EXAMINATION
B.Tech. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING
SECOND YEAR, THIRD SEMESTER**

S. No.	Course No.	Subject	Periods			Evaluation Scheme				Credits	
			L	T	P	Sessional Exam			ESE		
						IA	MSE	Total			
01	CH3THS03	Engineering Economics	3	0	0	20	20	40	60	100	3
02	CH3TPC01	Fundamentals Chemical Engineering	3	0	-	20	20	40	60	100	3
03	CH3TES05	Fluid Mechanics	3	1	-	20	20	40	60	100	4
04	CH3TBS05	Engineering Mathematics-III	3	1	-	20	20	40	60	100	4
05	CH3TES06	Chemical Engineering Thermodynamics-I	3	0	-	20	20	40	60	100	3
06	CH3TPC02	Chemical Engineering Calculations	3	0	-	20	20	40	60	100	3
PRACTICAL											
01	CH3PPC01	Chemical Engineering Lab	-	-	3	-	-	30	20	50	2
02	CH3PES05	Fluid Mechanics Lab	-	-	3	-	-	30	20	50	2
TOTAL			18	2	6				700		24

IA - Internal Assessment MSE - Mid Semester Examination ESE - End Semester Examination
Total Marks - 700 Total Periods - 26 Total Credits - 24

Dr. Chandan Chandra
Professor & Head
Chemical Engineering
Jadavpur University

Date: 24/06/16



CH3TES05: Fluid Mechanics (3+1+0)

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, Kinetic energy, Friction factor, Pump work.

Unit III : Incompressible Fluids : Flow through pipes, Flow characteristics- Shear stress, Friction factor, Laminar flow for newtonian fluids, Hagen Poiseuille 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, Troubleshooting in operation - Priming & cavitations, 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 : Agitation and Mixing of Liquids : Various types of agitators, impellers, propellers, turbines, paddles, Standard turbine design, Circulation velocities and power calculations in agitation process including power correlations, Effects of baffles, blending and mixing, Dimensional analysis, Shell balances.

Books Recommended :

1. Unit Operations of Chemical Engineering by McCabe Smith And Harriot, Fifth Edition, McGraw Hill Inc.
2. Chemical Engineering by J.M. Coulson and Richardson Vol.-II
3. Unit Operation in Chemical Engineering by Chattopadhyay, Khanna publishers.

BOS held on 24th June 2016

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CH3TES06: Chemical Engineering Thermodynamics-I (300)

Unit I: 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 & Second Laws of Thermodynamics: First & Second laws, Calculation of internal energy, Enthalpy, Heat capacities, Application of first law for open and closed systems, Throttling process, Joule - Thompson effect.

Second law - Kelvin-Planck statement, Clausius statement, Carnot's cycle, Carnot theorem, Clausius inequality, Entropy and its calculation.

Unit III: Third Law of Thermodynamics: Definition and applications.
Statistical & Non-equilibrium Thermodynamics: Basic concepts 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.

Unit V: Equation of State, VLE/LLE Equilibrium: Le Chatlier's Principle, Kinetic theory, Vapour-liquid equilibria in ideal solution, Liquid-liquid equilibrium diagrams, Equation of state of real gas, Principles of corresponding states

Books Recommended:

1. Chemical Engineering Thermodynamics by Y.V.C. Rao, Universities Press(India) Ltd. Hyderabad.
2. Engineering Thermodynamics by P. K. Nag, Tata McGraw Hill.
3. Principle of Physical Chemistry by Meron, Samuel H. Pruton Carl F., Oxford & IBH publishing Co. Pvt. Ltd. New Delhi.
4. Textbook of Physical Chemistry by Samuel Glasstone, Macmillan Co. Ltd. London.
5. Chemical Engineering Thermodynamics by B.F. Dodge.

BUS held on 24th June 2016



CHETPC02: Chemical Engineering Calculation (30 B)

Unit I : Review : Concepts of units & dimensions, Pressure, Temperature, Volume, Moles, Average molecular weight, Stoichiometry & composition relationships.

Unit II : Gaseous Processes : Ideal gas law, Dalton's law, Amagat's law, Partial pressure and pure component volume, Different methods of solving problems related to gaseous mixture and chemical reactions in gaseous phase.

Unit III : Vapor Pressure : Concepts of vapor pressure, Vapor pressure of immiscible liquids, Antoine equation, Cox chart, Vapor pressure of solutions and problems based on Raoult's law.

Humidity & Saturation : Difference between saturation & humidity, Different methods of expressing saturation & humidity, Psychrometry & its problems.

Unit IV : Material Balance : General equation and concept of law of conservation of mass, Problems on material balance with & without chemical reaction, Recycle, Bypass & purge calculations, Specific type of industrial applications on above.

Unit V : Energy Balance : General heat balance equation and concept of law of conservation of energy, Combustion calculations, Reaction and flame temperature calculations, Heat balances for reacting & non-reacting processes, Specific type of industrial applications of above.

Books Recommended :

1. Chemical Process Engineering Calculation by S.M. Saha, Chapman and Hall (Pvt) Ltd, New Delhi.
2. Chemical Process Principles Part I by Hougden, Watson & Ragatz Vol. I, Asia Publishing house.
3. Basic Principles & Calculations in Chemical Engineering by D.M. Himmelblau, Prentice Hall.
4. Stoichiometry by R. I. Shott and S.M. Vora, Tata McGraw Hill Pub Co.

Dr. Chandan C. Laha

Dr. Chandan C. Laha
Professor & Head
Chemical Engineering Dept.
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BOB held on 24th June 2016

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INSTITUTE OF TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
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SCHEME FOR EXAMINATION
B.Tech. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING
SECOND YEAR, FOURTH SEMESTER

Sl. No.	Course No.	Subject	Periods			Evaluation Scheme					Credits
			L	T	P	Sessional Exam			ESE	Sub Total	
						IA	MSE	Total			
01	CH4THS05	Business Communication and Presentation Skill	3	0	-	20	20	40	60	100	3
02	CH4TBS06	Numerical Analysis & Computer Applications	1	1	-	20	20	40	60	100	4
03	CH4TPC02	Chemical Engineering Thermodynamics -II	1	1	-	30	20	40	60	100	3
04	CH4TPC03	Inorganic Chemical Technology	3	0	-	20	20	40	60	100	3
05	CH4TPC04	Mechanical Operations	3	0	-	20	20	40	60	100	3
06	CH4TPC05	Process Instrumentation	3	0	-	20	20	40	60	100	3
PRACTICAL											
01	CH4PBS03	Numerical Analysis & Computer Applications Lab	-	-	3	30	-	30	20	50	2
02	CH4PPC02	Mechanical Operation Lab	-	-	3	30	-	30	20	50	2
TOTAL			18	2	6					700	24

IA - Internal Assessment

Total Marks - 700

MSE - Mid Semester Examination

Total Periods - 26

ESE - End Semester Examination

Total Credits - 24

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B.Tech. IV Semester

CH4THS05: Business Communication and Presentation Skill (300)

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;

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

Reference books:

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

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CH4TBS06: Numerical Analysis & Computer Applications (31 0)

UNIT - I Approximations and Errors in Computation: Errors and their analysis, Types of errors Curve fitting - Method of Least squares , fitting of a straight line , fitting of an exponential curves , polynomial fit . Non linear Regression (second degree parabola) , Least Square Approximation , Method of moments.

UNIT - II Numerical Solution of Algebraic and Transcendental Equations: Graphical method Bisection Method, Secant Method, Regula falsi Method, Newton Raphson Method, Iteration Method Solution of a system of simultaneous linear algebraic Equations Direct method: Gauss elimination Method, Gauss Jordan method, Iterative methods Jacobi Iterative Method, 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. Central difference interpolation formula:-gauss's forward and backward interpolation formula, Sterling's formula Bessel's formula, Laplace - Everett's formula, choice of interpolation formula. Interpolation with Unequal intervals: - Lagrange's interpolation Newton's difference formula, inverse interpolation.

UNIT -IV Numerical Differentiation and Integration: - Numerical Differentiation Newton's forward and Backward difference interpolation formula. Maxima and Minima of a Tabulated function, Numerical Integration :- Newton-cotes's quadrature formula Trapezoidal rule , simpson is (1/3)rd and (3/8) th rule , Boole's rule, weddle rule , Difference Equations :- Definition ,order and degree of a difference equation , Linear difference equations, Difference equations reducible to Linear form , simultaneous difference equations with constant coefficients

UNIT - V Numerical solution of ordinary differential equation : Taylor series method , Picard's Method , Euler's method, Modified Euler method Runge's method Runge Kutta method , Numerical solution of partial differential Equations : Classification of P.D.E. of the second order Elliptic equations , solution of Laplace equation , solution of poisson's Equation, solution of elliptic equations by Relaxation method parabolic equations .

Books Recommended :

1. JAIN & INGAR Numerical Methods for Scientific and Engineering Computations.
2. RAD G.S. Numerical Analysis.
3. Grewal B S Numerical Methods in Engineering and Science.
4. Das K K Advance Engineering Methods.
5. Rajaraman V Computer Oriented Numerical Methods

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CH4TPC03: Inorganic Chemical Technology (300)

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.

Books Recommended :

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

Agarwal

R.G.

Dr. Ananta Kumar Datta
Professor & Head
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BOS held on 24th June 2016

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CH4TPC04: Mechanical Operations (300)

Unit I : Solids Properties, Handling, Mixing, Storage & Transportation :
Characterization of solid particles, Particle shape, Size, Size analysis, Number of particles in mixture, Screen analysis, Standard screens, Size measurement for fine particles, Storage of solids, Conveying of solids - Mechanical and pneumatic (brief descriptions)
Mixing of Solids : Types of important mixers like kneaders, dispersers, masticators, roll mills, muller mixer, pug mixers, blenders, screw mixer etc. Mixing index.

Unit II : Size Reduction : Principle, Major equipment- Crushers, grinders, ultrasonic grinders, cutting machines, Energy & power calculations for size reduction, Closed circuit and open circuit grinding.

Unit III : Settling : Elutriation, Classification and sedimentation, Flow of solids through fluids, Stokes law, Free and hindered settling, Types of thickeners (batch & continuous), Settling chambers, Cyclones & multi-cyclones and their design, Dust and dump collectors, Electrostatic precipitators, Filter bags, Venturi scrubbers.

Unit IV : Mechanical Separations : Industrial screens; their capacity and effectiveness
Filtration : Theory, Batch and continuous filtration equipment and their functioning, Filter aids, Clarifiers.- Principles only, Centrifugal separation for liquids decanters.

Unit V : Fluidization : Flow of fluids through beds of particles, Kozeny-Carman equation, Burke - Plummer Equation, Ergun equation, Aggregate and particulate fluidization, Fluidization velocity, Porosity, Expansion of fluidized bed, Industrial applications.

Books Recommended :

1. Unit operations of Chemical Engineering by McCabe Smith and Harriot, Fifth edition, McGraw Hill Inc.
2. Chemical Engineering by J. M. Coulson and Richardson Vol. -II.
3. Unit Operations for Chemical Engineering by G. G. Brown & Associates.
4. Unit Operations in Chemical Eng. by P. Chattopadhyay, Khanna Publishers.

Dr. Chandan Guba
Professor & Head
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BOS held on 24th June 2016

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CH4TPC05: Process Instrumentation (3 0 0)

Unit-I : Process Variables : Introduction to process variables, Static and dynamic characteristics of instruments and their general classification.

Unit-II : Measuring Systems : Elements of measuring system and their functions; Signal transmission; Transmitters : Electronic, pneumatic, transducers.

Unit-III : Measuring Instruments : Principles, Construction and operations of instruments for the measurement, transmission, control/ indication/ recording of various process variables such as temperature, pressure, flow, liquid level, humidity and composition.

Unit-IV : Electro-Pneumatic Transducer : Principles and construction of electro-pneumatic transducer, Pneumatic to electrical converter, Multiplexers, Construction and characteristics of final control elements such as pneumatic control valve, Stepper motor, Motorized valve, Principles and construction of pneumatic and electronic controller.

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

Books:

1. Patranabis, D, "Principles of Industrial Instrumentation", Tata McGraw-Hill Publishing Co. Ltd
2. Beckwith, T.G., Marangoni, R.D. and Lienhard, J.H., "Mechanical Measurements", Addison Wesley.
3. Jain, R.K., "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi
4. Johnson, C.D., "Process Control Instrumentation Technology", Pearson Education, Inc.

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Dr. Chandan Choudhary
Professor & Head
Chemical Engineering Dept
Jadavpur University, Kolkata

BOS held on 24th June 2016

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

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

THIRD YEAR, FIFTH SEMESTER

S. No.	Course No.	Subject	Periods			Evaluation Scheme					Credits
			L	T	P	Sessional			ESE	Sub Total	
						IA	MSE	Total			
01.	CH5TPC06	Heat Transfer	3	1	0	20	20	40	60	100	4
02.	CH5TPC07	Mass Transfer-I	3	1	-	20	20	40	60	100	4
03.	CH5TPC08	Chemical Reaction Engineering-I	3	1	-	20	20	40	60	100	4
04.	CH5TPE1X		3	1	-	20	20	40	60	100	4
05.	CH5TOE1X		3	0	-	20	20	40	60	100	3
PRACTICAL											
01.	CH5PPC03	Heat Transfer Lab	-	-	3	30	-	30	20	50	2
02.	CH5PPC04	Mass Transfer-I Lab	-	-	3	30	-	30	20	50	2
03.	CH5PPC05	Chemical Reaction Engineering Lab	-	-	3	30	-	30	20	50	2
TOTAL			15	4	9					650	25

IA - Internal Assessment

MSE - Mid Semester Examination

ESE - End Semester Examination

Total Marks - 650

Total Periods - 28

Total Credits - 25

BOS held on 24th May 2017

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

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

THIRD YEAR, SIXTH SEMESTER

S. No.	Course No.	Subject	Periods			Evaluation Scheme					Credits
			L	T	P	Sessional			ESE	Sub Total	
						IA	MSE	Total			
01.	CH6TPC09	Mass Transfer-II	3	1	-	20	20	40	60	100	4
02.	CH6TPC10	Process Dynamics and Control	3	1	-	20	20	40	60	100	4
03.	CH6TPC11	Organic Chemical Technology	3	-	-	20	20	40	60	100	3
04.	CH6TPE2X		3	1	-	20	20	40	60	100	4
05.	CH6TPE3X		3	1	-	20	20	40	60	100	4
06.	CH6TOE2X		3	0	-	20	20	40	60	100	3
PRACTICAL											
01.	CH6PPC06		-	-	3	30	-	30	20	50	2
02.	CH6PPC07		-	-	3	30	-	30	20	50	2
TOTAL			18	4	6					700	26

IA - Internal Assessment
Total Marks - 700

MSE - Mid Semester Examination
Total Periods - 28

ESE - End Semester Examination
Total Credits - 26

24/5/17 BOS held on 24th May 2017
विभागाध्यक्ष, रासायनिक अभियांत्रिकी
HoD, Chemical Engineering
प्रौद्योगिकी संस्थान, Institute of Technology
गुरु घासीदास विश्वविद्यालय, बिलासपुर (छ.ग.)
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

I agree
Dr. Chandan Guha
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DEPARTMENT OF CHEMICAL ENGINEERING
INSTITUTE OF TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

**LIST OF PROFESSIONAL ELECTIVES OFFERED BY THE DEPARTMENT OF CHEMICAL
FOR V and VI SEMESTER**

Semester	Subject Code (PE)	Subject
V	CH5TPE11	Engineering Material
	CH5TPE12	Fundamentals of Biochemical Engineering
	CH5TPE13	Food Engineering
	CH5TPE14	Polymer Technology
VI	CH6TPE21	Process Equipment Design-I
	CH6TPE22	Fertilizer Technology
	CH6TPE31	Fuel Combustion Energy Technology
	CH6TPE32	Environmental Engineering

PE - Professional Elective

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B.Tech. V Semester

CH5TPC06: Heat Transfer (310)

Unit I :Conductive Heat Transfer: Heat transfer by conduction in solid, Fourier's Law, Compound resistance in series, Heat flow through a cylinder, Unsteady state heat conduction with applications.

Unit II : Convective Heat Transfer : Heat transfer by forced convection in laminar and turbulent flow, Natural convection, Counter current, parallel flow, cross flow, Thermal analysis of heat exchangers, Rate of heat transfer, Overall heat transfer coefficient, Individual heat transfer coefficient, Fouling factors.

Unit III :Radiative Heat Transfer : Electromagnetic radiation, Radiation heat transfer, Wien's displacement law, Kirchoff's law, Stefan-Boltzmann law, Radiation between surfaces, Combined heat transfer by conduction, convection and radiation.

Unit IV :Heat Transfer Equipments : Heat exchangers and general design of parallel, countercurrent, Shell & tube heat exchangers, Extended surface equipment.

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, Vapor recompression, Heat transfer from condensing vapours, Heat transfer to boiling liquids.

Text Books:

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

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CH5TPC07: Mass Transfer - I (310)

Unit I: Principle of Diffusion :Theory of diffusion, molecular diffusion in gases and liquids, Diffusion velocities, Mass transfer coefficient for mass transfer through known areas.

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 plates - Lewis soresl 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.

Text Books:

1. Mass Transfer by Robert E Treybl, McGraw Hill Inc.
2. Unit Operations of Chemical Engineering by McCabe Warren, Smith Julian C andHarriot Peter. Fifth edition McGraw Hill Inc.
3. Principles of Mass Transfer and Separation Processes by B. K. Dutta, Prentice Hall, 2005.
4. Transport Processes and Unit Operations by C. J. Geankoplis, Prentice Hall International Inc.
5. Chemical Engineering Vol. I by Coulson J.M. & Richardson J.F.
6. Introduction to Chemical Engineering by Badger & Bancherco, TATA McGraw Hill inc.

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CH5TPC08: Chemical Reaction Engineering-I (310)

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 reactor, 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, Favorable 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, van Heerden relationship.

Multiple reaction: Temperature and vessel size for maximum production.

Text Books:

1. Chemical Engineering kinetics by J.M. Smith
2. Chemical Reaction Engineering by O Levenspical
3. Elements of Chemical reaction Engineering by H.S. Foggler

Reference Book:

1. Reaction Kinetics for chemical Engineering by S. H. Walas

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CH5TPE13: Food Engineering (3 1 0)

Unit I: Introduction- General aspects of food industry, world food demand and Indian scenario, constituents of food, quality and nutritive aspects. Food additives, standards, deteriorative factors and their control, preliminary processing methods, conversion, preservation operation and quality standards.

Unit II Energy Engineering in Food Processing - Generations of Steam, Fuel Utilization, Electric Power Utilization, Process Controls in Food Processing, Systems for Heating and Cooling Food Products.

Material and energy balance in food systems and calculation. Common unit operations in food processing - Cleaning, evaporation, crystallization. Thermal Properties of Foods: Specific heat, Enthalpy, Thermal Conductivity, Thermal diffusivity, Latent heat, Modes of Heat Transfer - Freezing Systems, Frozen-Food Properties, Freezing Time refrigeration system for food products.

Unit III- Separation processes in food processing- Electrodialysis Systems, Reverse Osmosis Membrane Systems, Membrane Performance, Ultrafiltration Membrane Systems, Concentration Polarization. Types of Reverse-Osmosis and Ultrafiltration Systems, Drying Processes, Dehydration Systems, Dehydration System Design, Sedimentation, Centrifugation, Mixing.

Unit IV- Production and utilization of food products -Food Process Principles: Pasteurization, Blanching, Sterilization techniques and types. Soft and alcoholic beverages, dairy products, meat, poultry and fish products, treatment and disposal of food processing wastes.

Unit V. Packaging - Introduction, Food Protection, Product Containment, Product Communication, Product Convenience. Innovations in Food Packaging, Food Packaging and Product Shelf-life, Food canning technology, fundamentals of food canning technology.

Text book:

1. Introduction to Food Engineering by R. Paul Singh, Dennis R. 5th Edition

Reference books:

1. Fundamentals of Food Engineering by Stanley Cherm.
2. Fundamentals of Food Process Engineering by Toledo RT; 2nd ed, 2000, CBS Publishers
3. Fundamentals of Food Processing Operation by Heid, J.L. and Joslyn, M.A, The AVI Publishing Co; Westport, 1967.
4. Food Process Engineering by Heldman, D.R, The AVI Publishing Co; Westport, 1975.
5. Encyclopedia of Food Engineering by Hall, C.W; Farall, A.W. & Rippen, A.L, Van Nostrand - Reinhold.

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B.Tech. VI Semester

CH6TPC09: Mass Transfer - II (310)

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

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

Unit III : Liquid- Liquid Extraction : Equipment, Principles of extraction, Ponchon - Savarit 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.

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

Text Books:

1. Mass Transfer by Robert E Treybl, McGraw Hill Inc.
2. Unit Operations of Chemical Engineering by McCabe Warren, Smith Julian C and Harriot Peter, Fifth edition, McGraw Hill Inc.
3. Principles of Mass Transfer and Separation Processes by B. K. Dutta, Prentice Hall, 2005.
4. Transport Processes and Unit Operations by C. J. Geankoplis, Prentice Hall International Inc.
5. Chemical Engineering Vol. I by Coulson J.M. & Richardson J.F.
6. Introduction to Chemical Engineering by Badger & Bancherco, TATA McGraw Hill Inc.

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CH6TPC10: Process Dynamics and Control (3 1 0)

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 behavior 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 from 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; Nyquist stability criterion

Text Books:

1. Process Systems Analysis and Control by D.R. Coughnawr, McGraw-Hill, Inc.
2. Chemical Process Control by G. Stephanopolous, Prentice-Hall.
3. Process Control by P. Hariott, TMH edn.

Reference Books:

1. Process Dynamics and Control by D.E. Seborg, T. Edgar and D.A. Mellichamp, John Wiley and Sons, Inc
2. Process Control: Modeling, Design, and Simulation by B.W. Bequette, Prentice-Hall, Inc.

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CH6TPC11: Organic Chemical Technology (300)

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, Khandasari 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 its distribution, Selected industrial polymerization including plastics, Synthetic rubber and polymeric foams, Synthetic fibers. **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.

Text Books:

1. Chemical Process Industries - R.N. Shrivastava & J.A. Brink
2. Chemtech I, II, III, IV - IIT Madras
3. Outlines of Chemical Technology by Dryden, Co. M.G. Rao and M. Sittling.

Reference Book:

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

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CH6TPE21: Process Equipment Design-I (3 1 0)

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

Text Books:

1. Introduction to Chemical Equipment Design (Mechanical Aspects) by B.C. Bhattacharya- Chemical Engineering Education Development Center.
2. Process Equipment Design By Brownell & Young
3. Process Equipment Design by M.V. Joshi
4. Chemical Engineering by Coulson J.M., Richardson Vol- I
5. Process Equipment Design by Shrikant D. Dawande

Reference Books:

1. Hand book of Chemical Engineering by J.H.Perry
2. IS Codes.

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CH6TPE22: Fertilizer Technology (3 1 0)

Chemical fertilizers and organic manures - types of chemical fertilizers, Nitrogenous fertilizers- Methods of production, Characteristics, Specification and storage of ammonium sulphate, ammonium nitrate and ammonium chloride and urea Phosphatic fertilizers- Methods of production, Characteristics, Specification and storage of single super phosphate, triple super phosphate, Potassic fertilizers- Methods of production, Characteristics, Specification and storage of potassium chloride, potassium sulphate and potassium schoenite, Complex and NPK fertilizers-Methods of production, Characteristics, Specification and storage of Mono ammonium phosphate, Diammonium phosphate, Nitrophosphates, Fertilizers And Environment.

Text Books :

1. Commercial Fertilizers by G.H. Collings, 5th Edn., McGraw Hill, New York, 1955.
2. Chemistry and Technology of Fertilizers by A.V. Slacks, Interscience, New York, 1966.

Reference Book :

1. Editorial board-Handbook of fertilizer technology, The Fertilizer Association of India, New Delhi, 1977.

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CH6TPE31: Fuel Combustion Energy Technology (310)

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 Carbureted 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 Inflammability, 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.

Text Book:

1. Elements of Fuel Combustion & Energy Engineering by S.N. Saha, Dhanpat Rai Publication Co. Pvt. Ltd. New Delhi, 2014

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INSTITUTE OF TECHNOLOGY

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)

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

SCHEME FOR EXAMINATION

B.Tech. (FOUR YEAR DEGREE COURSE) - CHEMICAL ENGINEERING

FOURTH YEAR, SEVENTH SEMESTER

Paper Code	Subject	Periods			Evaluation Scheme		Total	Credits
		L	T	P	IA	ESE		
THEORY								
CH4701	Project Engineering, Economics & Management	3	1	-	40	60	100	4
CH4702	Process Equipment Design - II	3	1	-	40	60	100	4
CH4703	New Separation Processes	3	1	-	40	60	100	4
CH4704	Transport Phenomena	3	1	-	40	60	100	4
CH4705-06	Elective - I*	3	1	-	40	60	100	4
PRACTICAL								
CH4707	Computer Aided Design & Simulation	-	-	3	30	20	50	2
CH4708	Vocational Training Viva Cum Seminar	-	-	3	30	20	50	2
CH4709	Minor Project	-	-	3	30	20	50	2
Total							650	26

IA - Internal Assessment

ESE - End Semester Examination

* CH4705 : Petroleum Refinery Engineering

CH4706 : Polymer Technology- I

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SCHEME FOR EXAMINATION
B.Tech. (FOUR YEAR DEGREE COURSE) - CHEMICAL ENGINEERING
FOURTH YEAR, EIGHTH SEMESTER

Paper Code	Subject	Periods			Evaluation Scheme		Total	Credits
		L	T	P	IA	ESE		
THEORY								
CH4801	Process Utilities and Safety	3	1	-	40	60	100	4
CH4802	Optimization Techniques in Chemical Engineering	3	1	-	40	60	100	4
CH4803	Environmental Pollution Control Engineering	3	1	-	40	60	100	4
CH4804-05	Elective - II*	3	1	-	40	60	100	4
PRACTICAL								
CH4806	Environmental Pollution Control Engineering	-	-	3	30	20	50	2
CH4807	Major Project	-	-	12	90	60	150	6
CH4808	Comprehensive Viva	-	-	-	-	50	50	2
Total							650	26

IA - Internal Assessment

ESE - End Semester Examination

* CH4804 : Petrochemical Engineering

CH4805 : Polymer Technology- II

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B. Tech. VII Semester

CH4701: Project Engineering, Economics & Management (3 1 0)

Unit I : Project Engineering : Introduction to project engineering, Difference between project & process engineering, Role of a project leader, General design considerations, Plant layout and site selection, Flow diagram- qualitative & quantitative, Concept of scale up, Concepts of techno-economic feasibility report.

Unit II : Project Finance & Accounts: Elementary knowledge of book of accounts-Journal, Ledger, Balance sheet, P/L a/c, Cost and asset accounting methods, Cost estimation, Cash flow investment, Production cost, Capital investment, Cost indices, Production and overhead cost, Interest and taxes;

Unit III : Profitability & Alternative Investments: Depreciation and its calculation methods, Scrap value, Salvage value, Book value, Market value, Methods of calculating profitability, Alternative investments, Replacement of assets, Rate of return, Payback period, Discounted cash flow.

Break Even Analysis: Break even analysis, Break even chart & its importance.

Unit IV: Project Scheduling: Importance of project and required scheduling and steps, Network techniques, CPM, PERT, Gantt Chart.

Unit V: HR Personnel & Administration : Importance & role of this management function, Recruitment Process, Training & development, Job evaluation-Job analysis, Performance appraisal, Wages & salary, Administration, Wage policy, Wage survey, Negotiation, Rewards, Motivation, Job enlargement & job enrichment, Brief concepts of public relations, Brief introduction to Indian Factories Act.

Books Recommended

1. Plant Design & Economics for chemical Engineers by M.S. Peters & K. D. Timmerhaus.
2. Engineering Economics by Tarachand

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CH4702 : Process Equipment Design- II (3 1 0)

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

Books Recommended

1. Hand Book of Chemical Engineering J. H. Perry
2. Coulson & Richardson Vol - VI
3. Mass Transfer by R. 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 centers.

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CH4703 : New Separation Processes (3 1 0)

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 .

Unit II: Membrane Separation Processes: Principle of membrane separations process, Advantages and disadvantages; Classification, membrane materials, general methods of preparation and characterization of membranes; Membrane modules; Transport equations and concentration polarization

Unit III : Porous Membrane Based Processes: Reverse osmosis, Ultra-filtration, Micro-filtration, 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; Gas separation, Supported and un-supported liquid membranes and their industrial applications; Carrier facilitated transport

Medical applications of membrane; Miscellaneous membrane processes- dialysis, membrane distillation, membrane reactors

Unit V: Other Non-conventional Separation Processes: Foam and bubble fractionation: Principle, classification, separation techniques, column operations; Adsorptive and Extractive Separation- Pressure and temperature swing adsorption, Cryogenic separation, Super- critical fluid extraction; Parametric pumping- Batch, continuous and semi-continuous pumping, Thermal, pH and heatless parametric pumping.

Books:

1. Seader, J D, and Henley E J, "Separation Process Principles", John Wiley & Sons, Inc.
2. King, C.J, "Separation Processes", McGraw-Hill, Inc.
3. Nath, K, Membrane Separation Processes, PHI, New Delhi (2008)
4. Baker, R W, Membrane Technology and Applications, John Wiley and Sons, Ltd, UK (2004)

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CH4705 : Petroleum Refinery Engineering (3 1 0)

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 a petroleum industries.

Unit IV : Cracking & Reforming Operation : Cracking, Type of cracking, Thermal cracking reaction, Dubbs process & tube still process of thermal cracking, Visbreaking, 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.

Books Recommended :

1. Petroleum Refinery Engineering by W.L. Nelson
2. Petroleum Refining by Gary and Handwarka, Marcel Dekker
3. Petroleum Refining & Petrochemicals by N.K. Sinha, Icmesh Publications New Delhi.

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CH4802: Optimization Techniques in Chemical Engineering (3 I 0)

Unit I : System Analysis and Modeling : Introduction to systems analysis and modeling 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 : Modeling, 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.

Book Recommended:

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

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CH4803 : Environmental Pollution Control Engineering (3 1 0)

Unit I : Environmental Pollution and Its Effect : Environment and its components, Sources and type of pollutants, General effects on man, animal, vegetation and property.

Unit II : Air Pollution : Air quality criteria and standards, Ambient air sampling and analysis, Stack emission standards, Stack sampling and analysis, Meteorology and dispersion of air pollutants, Atmospheric lapse rate and stability, Plume behavior, Control of gaseous and particulate pollutants from mobile and stationary sources.

Unit III : Water Pollution : Water quality criteria and effluent discharge standards, Domestic and industrial sources of waste water, Waste water sampling and analysis methods as per BIS specifications, Physico-chemical and biological methods of waste water treatment, Recovery of material from process effluents.

Unit IV: Pollution Due to Hazardous Industrial Waste : Nature of hazardous waste materials from various chemical and allied industries, Methods of disposal, destruction and reuse, Nuclear wastes and their management. Solid waste from commercial, domestic and industrial sectors-composition and characterization, recycle, resource recovery and disposal.

Unit V: Environmental Pollution Management : Case studies of air and water pollution control in chemical industries.

Books Recommended :

1. Environmental Pollution Control Engineering by C. S. Rao, New Age International Ltd.
2. Environmental Engineering by N N Basak, Tata McGraw-Hill Pub. Co. Ltd.
3. Essentials of Environmental Studies by K. Joseph and R. Nagendran, Pearson Education (Singapore) Pvt. Ltd.

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CH4804 : Petrochemical Technology (3 1 0)

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.

Books Recommended :

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

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INSTITUTE OF TECHNOLOGY
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(A Central University Established by Central University Ordinance 2009, No 3 of 2009)

SCHEME FOR EXAMINATIONS

M.Tech. (TWO YEARS POST GRADUATE COURSE), CHEMICAL ENGINEERING

FIRST YEAR

FIRST SEMESTER

S. No.	Course No.	Subject	Periods /week	Evaluation Scheme			Credits
	Theory			IA	ESE	Sub. Total	
01.	CHPG1101	Advanced Heat Transfer	3	40	60	100	3
02.	CHPG1102	Chemical Reactor Design	3	40	60	100	3
03.	CHPG1103	Fluidization Engineering	3	40	60	100	3
04.	CHPG1104	Process Optimization	3	40	60	100	3
05.	CHPG1105	Elective - I	3	40	60	100	3
Practical							
06.	CHPG1106	Chemical Engineering Computational Lab	3	50	--	50	2
Total						550	17

IA- Internal Assessment

Total Marks - 550

ESE- End Semester Examination

Total Credits - 17

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SCHEME FOR EXAMINATIONS

M.Tech. (TWO YEARS POST GRADUATE COURSE), CHEMICAL ENGINEERING

FIRST YEAR

SECOND SEMESTER

S. No.	Course No.	Subject	Periods /week	Evaluation Scheme			Credits
	Theory			IA	ESE	Sub. Total	
01.	CHPG1201	Advanced Fluid Mechanics	3	40	60	100	3
02.	CHPG1202	Advanced Mass Transfer	3	40	60	100	3
03.	CHPG1203	Industrial Pollution Control Technologies	3	40	60	100	3
04.	CHPG1204	Design and Development of Catalyst	3	40	60	100	3
05.	CHPG1205	Elective - II	3	40	60	100	3
Practical							
06.	CHPG1206	Project	3	50	--	50	2
07.	CHPG1207	General Seminar	2	50	--	50	1
Total						600	18

IA- Internal Assessment

Total Marks - 600

ESE- End Semester Examination

Total Credits - 18

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Elective - I (CHPG1105)

1. Operations Research & Management
2. Advanced Wastewater Treatment Technology
3. Numerical Methods for Chemical Engineering
4. Chemical Process Modeling
5. **Membrane Separation Processes**

Elective - II (CHPG1205)

1. Safety Hazards & Risk Analysis
2. Advanced Process Control
3. Steady State Process Simulation
4. Process Intensification

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Institute of Technology,
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

M.Tech. (Chemical Engineering)

CHPG1101 : Advanced Heat Transfer

General equation of heat conduction, Transient heat Conduction numerical and analytical methods for the solution of transient heat conduction problems, Critical radius and optimum thickness of insulation. Free convective heat transfer under different situation and application of dimensional analysis to estimate the convective heat transfer coefficients. Heat transfer factor Reynolds No. Plot, Analogy equation for heat momentum transfer. Boiling heat transfer with particular reference to Nucleate and film boiling and estimation of boiling heat transfer coefficient. Heat transfer from condensing vapors. Nusselt equation for film type condensation of vapors over vertical surfaces and inclined tubes. View factors and emmissivity factors for different situation. Radiation shield and radiation error in pyrometry. Combined conduction, convection and radiation heat transfer.

Texts/References

- Hallman J. P., Heat Transfer Operation, McGRAW-Hill
- R.C.Sachdeva ,Fundamentals of Engineering Heat & Mass Transfer ,
- Bird, R. B., Steward, W.E. and Lightfoot E N., Transport Phenomena, Second edition, John Wiley and sons,
- Deen W. M. Analysis of Transport phenomena, Oxford University Press, 1998.
- Slattery J. C., Momentum Heat and Mass Transfer, Krieger Publishing, 1981

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Institute of Technology,
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

M.Tech. (Chemical Engineering)

CHPG1102 : Chemical Reactor Design

Review of Design of ideal isothermal homogeneous reactor for single and multiple reactions, RTD of Ideal reactor, interpretation of RTD data, Flow models for non ideal reactors, dispersion model, N tanks in series, multi parameter model, diagnosing the ills of reactor, influence of RTD and micro mixing on conversion. Adiabatic and non adiabatic operations in batch and flow reactors, optimal temperature in progression. Hot spot in tubular reactor auto thermal operation and steady state multiple steady state introduction to bifurcation theory Catalytic reactors, effectiveness factor, selectivity, catalyst deactivation, Design of heterogeneous catalytic reactors.

Text/References

- James J Carberry: Chemical and catalytic reaction engineering McGraw Hill
- J M Smith " Chemical Engineering Kinetics", McHill
- O. Levenspiel, " Chemical Reaction Engineering", Wiley Eastern, 2nd ed. 1972
- Frinebt G. F. Bischoff K. B; " Chemical Reactor Analyzer and design" John Wiley & Sons
- H. S. Fogler; Elements of Chemical Reaction Engineering

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Institute of Technology,
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

M.Tech. (Chemical Engineering)

CHPG1103 : Fluidization Engineering

Phenomenon of Fluidization, Industrial applications of fluidized beds, Gross behavior of fluidized beds-Minimum fluidizing velocity and pressure drops; Voidage, Transport disengaging height; Bubbles in dense beds-Davidson Model, stream of bubbles, Bubbling bed models, 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; Flow Pattern of Gas through fluidized beds, diffusion model for gas flow; two region models, evaluation of interchange coefficients, Mass and heat transfer between fluids and solid- from bubbling bed models; Catalytic conversion from bubbling bed model; contacting efficiency; application to successive reactions; Theories and bed wall heat transfer; comparison of theories; Entrainment and elutriation, Circulation rates of solids, flow of high and low bulk density mixtures; Design for catalytic reactors; Design for non catalytic gas-solid reactors.

Text/References

- D Kuinl and O Levenpiel, Fluidization Engineering, John Wiley, 1969
- J. F. Davidson and D. Harrison, Fluidization, Academic Press 1971.
- F.A. Zenz and D. F. Othmer, Fluidization and Fluid Particles Systems, Reinhold Publishing, 1960

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Institute of Technology,
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

M.Tech. (Chemical Engineering)

CHPG1201 : Advanced Fluid Mechanics

The Physical Properties of Fluids, Newtonian and Non Newtonian and non viscous fluid, Kinematics of the Flow Field: Specification of the flow field, Continuity Equation in Cartesian, Cylindrical and Spherical coordinates, Derivation of general momentum equation for Newtonian fluid in Cartesian coordinates, Euler's Equations principles of rotational and irrotational flow, velocity potential, Bernoulli's Equation, Laplace equations, stream function, vorticity, Cauchy Riemann Equation, Analytical solution for simple two dimensional irrotational fluid flows: flow along to inclined plates. Stokes law of viscosity, Navier-Stokes equation, creeping flow around a solid sphere, expression for total drag, turbulent flow: transition to turbulence, Prandtl's mixing length, turbulence models. Boundary layer on immersed bodies, two dimensional boundary layer equation, laminar boundary layer on flat plate (Blasius Exact solution), Von-Karman's Integral momentum equation, boundary layer separation flow and pressure drag, flow of compressible fluids, thermodynamics considerations, continuity and momentum equation for one dimensional compressible flow.

Text/References

- Bird, R. B., Stewart, W.E. and Lightfoot E N., Transport Phenomena, Second edition.
- R. W. Fox, A.T. McDonald, P.J. Pritchard; Introduction to Fluid Mechanics, John Wiley 6th Edition.
- J.G. Knudsen, D.L. Katz; Fluid Dynamics & Heat Transfer, McGraw Hills

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Institute of Technology,
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

M.Tech. (Chemical Engineering)

CHPG1202 : Advanced Mass Transfer

Qualitative behavior of the vapour-liquid equilibria (VLE). Simple models for vapour- liquid equilibria: Raoult's and Henry's laws. Dew point and bubble point calculations. VLE by modified Raoult's law and K-value correlations. Flash calculations.

Ternary and multicomponent system, fractionation. Theories and design, No. of plates, Lewis Sorel's method, minimum reflux ratio, Underwood's equation, Colburn's equation.

Unsteady state mass transfer, multicomponent Gas-Phase systems, effective diffusivity, Maxwell's law, Regular and Random surface renewal, Harriot Model, Danckwerts model.

Mass Transfer across a phase boundary - the film-penetration theory, other theories of mass transfer. Interfacial turbulence, Mass Transfer coefficient, Applications of theories of interphase transfer. Mass Transfer and chemical reaction - steady state and unsteady state

Momentum, heat and mass transfer, molecular diffusion, Eddy diffusion, mixing length and eddy kinematics viscosity, overview of all separation processes including adsorption

Universal velocity profile - The laminar sub-layer, the buffer layer, Reynolds analogy, Taylor - Prandtl Modifications.

Text / References :

- J.D. Seader, Ernest J. Henley ; Chemical Engineering Principles.
- J.M. Coulson & J.F. Richardson; Chemical Engineering.

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Institute of Technology,
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M.Tech. (Chemical Engineering)

CHPG1203 : Industrial Pollution Control Technologies

Brief review of industrial, municipal and natural Pollution sources, dynamics of pollutants from point, non-point, line and area sources; Generation, transport and decay of air pollutants; Sampling and monitoring methods.

Strategies and methods for removal of gaseous pollutants and particulates from process exhaust streams; Air pollution abatement technology; Detail design of particulates and gaseous emission control equipment; Air pollution indices; Air pollution survey; Costs of air pollution control, Air Pollution legislation and regulations.

Case studies of a few industrial pollution control system

Waste water characteristics. Wastewater treatment objectives, methods and implementation considerations liquid hazardous waste treatment such as chemical, biological, and thermal oxidation, carbon adsorption, ion exchange.

Design of facilities for physical and chemical treatment; Design of facilities for treatment and disposal of sludge; Effluent disposal

Water pollution legislation and regulation

Text / References :

- K B Schnelle & C. A. Brown, Air Pollution Control Technology Handbook, CRC Press
- H. S. Peavy, Donald R Rowe & George Tchobanoglous, Environment engineering, McGraw-Hill
- R. K. Trivedy & P K Goel, An Introduction to Air Pollution, Technoscience Pub.
- Dharmendra S. Sengar; Environmental Law, PHI
- Dr B. C. Arun Ku. Jain, Ashok Ku. Jain; Waste Water Engineering.

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Institute of Technology,
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

M.Tech. (Chemical Engineering)

CHPG1204 : Design and Development of Catalysts

Structure of solid surfaces; Chemisorption and physisorption; Thermodynamics and kinetics of surface processes; Principles of heterogeneous catalysis; Preparation, characterization and classification; Structure and activity; Lattice imperfection; Geometric and electronic factors Preparation and characterization of catalysts.

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.

Electrocatalysis and photocatalysis.

Mechanism and kinetics of some typical heterogeneous catalytic reactions.

Applications in fertilizer, petroleum, petrochemical **industries and pollution control.**

Text / References :

- G. Poncelet, J. Martens, B. Delmon; Preparation of Catalyst VI : Scientific bases for the preparation of Heterogeneous Catalysts; Elsevier
- John Regalbuto; Catalyst Preparation : Science and Engineering; CRC Press

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Institute of Technology,
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

M.Tech. (Chemical Engineering)

Membrane Separation Processes

Principles, characteristic, and classification of membrane separation processes; Membrane materials, structures, and preparation techniques; Membrane modules; Plant configurations.

Membrane characterization: Pore size and pore distribution; Bubble point test; Challenge test; Factors affecting retentivity, concentration polarization, gel polarization, fouling, cleaning and regeneration of membranes.

Mechanisms of separation: Porous membranes, dense membranes, and liquid membranes.

Membrane separation models: Irreversible thermodynamics; Capillary flow theory; Solution diffusion model; Science and technology of microfiltration, reverse osmosis, ultrafiltration, nanofiltration, dialysis and electrodialysis, pervaporation, liquid membrane permeation, gas permeation.

Membrane reactors: Polymeric, ceramic, metal and bio-membrane.

Texts/References

- J. D. Seader, Ernest J. Henley; Separation Process Principles.
- Phillip C. Wankat; Separation Process Engineering; PHI

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