Name of Course: B.Tech. (Chemical Technology/Leather Technology)

Harcourt Butler Technological Institute, Kanpur

Study and Evaluation Scheme

[Effective from the Session 2014-15]

B. Tech. (Chemical Technology/Leather Technology) **Year 2nd, Semester -III**

S.No.	Course Code	Subject	Periods			Evaluation Scheme				Subject Total	Credits
						Sessional Exam.			ESE		
			L	T	P	CT	TA	Total			
Theory Subjects											
1	ICH301	Material and Energy balance	3	1	0	30	20	50	100	150	4
2	ICH304	Fluid Flow and Solid handling	3	1	0	30	20	50	100	150	4
3											
4											
5											
Practical/Design											
6											
7											
8											

B. Tech. (Chemical Technology/Leather Technology) **Year 2nd, Semester -IV**

S.No.	Course Code	Subject	Periods			Evaluation Scheme				Subject Total	Credits
						Sessional Exam.			ESE		
			L	T	P	CT	TA	Total			
Theory Subjects											
1	ICH 401	Heat Transfer Operation	3	1	0	30	20	50	100	150	4
2	ICH 402	Chemical Engineering Thermodynamics	3	1	0	30	20	50	100	150	4
3											
4											
5											
6											
Practical/Design											
6	ICH 453	Chemical Engineering Operation Lab	0	1	3	30	20	50	50	100	4
7											

Name of Course: B.Tech. (Chemical Technology/Leather Technology)

Harcourt Butler Technological Institute, Kanpur

Study and Evaluation Scheme

[Effective from the Session 2015-16]

B. Tech. (Chemical Technology/Leather Technology) **Year 3rd, Semester-V**

S.No.	Course Code	Subject	Periods			Evaluation Scheme				Subject Total	Credits
						Sessional Exam.			ESE		
			L	T	P	CT	TA	Total			
Theory Subjects											
1	ICH 501	Instrumentation and Process Control	3	1	0	30	20	50	100	150	4
2	ICH 506	Chemical Reaction Engineering	3	1	0	30	20	50	100	150	4
3											
4											
5											
Practical/Design											
6											
7											
8											

B. Tech. (Chemical Technology) **Year 3rd, Semester-VI**

S.No.	Course Code	Subject	Periods			Evaluation Scheme				Subject Total	Credits
						Sessional Exam.			ESE		
			L	T	P	CT	TA	Total			
Theory Subjects											
1	ICH 603	Equipment Design	3	1	0	30	20	50	100	150	4
2	ICH 606	Mass Transfer Operation	3	1	0	30	20	50	100	150	4
3											
4											
5											
Practical/Design											
6	ICH 653	Instrumentation and Process Control Lab	0	0	3	30	20	50	50	100	4
7											
8											

Name of Course: B.Tech. (Chemical Technology/Leather Technology)

Harcourt Butler Technological Institute, Kanpur

Study and Evaluation Scheme

[Effective from the Session 2016-17]

B. Tech. (Chemical Technology/Leather Technology) **Year 4th, Semester -VII**

S.No.	Course Code	Subject	Periods			Evaluation Scheme				Subject Total	Credits
						Sessional Exam.			ESE		
			L	T	P	CT	TA	Total			
Theory Subjects											
1	ICH 701	Process Modeling and Simulation	3	1	0	30	20	50	100	150	4
2											
3											
4											
5											
Practical/Design											
6											
7											
8											

B. Tech. (Chem. Engg) **Year 4th, Semester -VIII**

S.No.	Course Code	Subject	Periods			Evaluation Scheme				Subject Total	Credits
						Sessional Exam.			ESE		
			L	T	P	CT	TA	Total			
Theory Subjects											
1											
2											
3											
4											
Practical/Design											
6											
7											
8											

ICH304 FLUID FLOW AND SOLID HANDLING

UNIT-I

Introduction to process fluid mechanics; Fundamental concepts: Definition of a fluid; Continuum hypothesis; Velocity field; Stress field; Newtonian and non-Newtonian fluids, Fluid statics: pressure variation in a static fluid, hydrostatic forces on submerged surfaces, buoyancy, Manometers. Dimensional analysis and similitude: Buckingham Pi theorem and applications

UNIT –II

Macroscopic Balances: derivation of integral balances for mass, energy and momentum; Derivation of engineering Bernoulli equation with losses, Application of macroscopic balances: Losses in expansion, Force on a reducing bend, Diameter of a free jet; Jet ejector. Flow measurement: Orifice meter, venturi meter, Pitot tube, and Rotameter.

UNIT –III

Differential balances of fluid flow: derivation of continuity and momentum (Navier-Stokes) equations for a Newtonian fluid, Boundary layer theory, Pipe flows and fittings: laminar and turbulent flows; friction factor charts, losses in fittings, Fluid transportation: Valves and Pumps and Compressors.

UNIT –IV

Flow through packed and fluidized beds: Flow through beds of solids, motion of particles through the fluid, Particle settling, Fluidization, minimum fluidization velocity, Mixing and Agitation- power consumption, mixing times, scale up

UNIT –V

Filtration: Governing equations, constant pressure operation, constant flow operation, cycle time, types of filters. Centrifuges and Cyclones: Gravity settling, centrifugal separation, cyclone separations, separation efficiency, pressure loss,

BOOKS:

1. Frank M. White, Fluid Mechanics (Sixth Edition), Tata McGraw-Hill, New Delhi (2008).
2. J. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall (1999).
3. W. L. McCabe, W. L. Smith, and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill International Edition (Sixth edition) (2001).
4. R. B. Bird, W. L. Stewart and E. L. Lightfoot, Transport Phenomena (Second edition), Wiley Singapore (2002).
5. M. M. Denn, Process Fluid Mechanics, Prentice Hall (1980).

ICH 453 CHEMICAL ENGINEERING OPERATION LAB

1. To determine and experimentally verify the type of flow using Reynolds apparatus
2. To determine and experimentally verify Bernoulli's equation using Bernoulli's apparatus
3. To find the friction losses in a Straight pipe, Pipe fittings and Valves & Bend pipe.
4. To determine and experimentally verify pressure drop in a packed bed by Ergun‟s equation.
5. To determine and experimentally verify minimum fluidization velocity in a fluidized bed
6. To determine and experimentally verify discharge coefficient of an orifice meter.
7. To determine and experimentally verify discharge coefficient of a Venturi meter.
8. To determine and experimentally verify discharge coefficient of a Rotameter.
9. To determine and experimentally verify discharge coefficient of a V notch in open channel.
10. To study the principle of a hydro-cyclone and find out the efficiency of separation.
11. To determine the average particle size of a mixture of particles by sieve analysis.
12. To determine and experimentally verify Ritinger‟s constant of Jaw crusher.
13. To determine reduction ratio, maximum feed size and theoretical capacity of crushing rolls.
14. To determine the effect of no. of balls on grinding in a Ball mill and comparison of its critical speed with the operating speed.
15. To find out enrichment of the coal sample using a froth flotation cell.
16. To determine and experimentally verify reduction ratio using Pulverizer.
17. To determine and experimentally verify the efficiency of separation of a cyclone separator.
18. To determine reduction ratio & experimentally verify reduction ratio of a Gyratory Crusher

ICH 506 CHEMICAL REACTION ENGINEERING

UNIT I

Rate of Reaction, Elementary and non-elementary homogeneous reactions, Molecularity and order of reaction, Mechanism of reaction, temperature dependency from thermodynamics, collision and activated complex theories. Integral and differential methods for analyzing kinetic data, interpretation of constant volume reactor, zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, catalytic reaction, auto catalytic reaction, reversible reactions.

UNIT II

Interpretation of variable volume batch reactions for zero, first and second order reactions, Space-time and state-velocity, design equation for ideal batch, steady-state continuous stirred tank, steady-state plug flow reactors for isothermal reaction.

UNIT III

Design for single reactions, Size comparison of single reactors, Multiple reactor systems, plug flow/mixed flow reactors in series and parallel, reactors of different types in series, optimum reactor size, recycle reactor, autocatalytic reactions.

UNIT IV

Introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size, selectivity, the side entry reactor, irreversible first-order reactions in series, Quantitative treatment: plug flow or batch reactor, Quantitative treatment: mixed flow reactor, Successive irreversible reactions of different orders, reversible reactions, irreversible series-parallel reactions, the Denbigh reactions and their special cases, Heat of reaction from thermodynamics, equilibrium constants from thermodynamics, General graphical design procedure for non-isothermal reactors, Optimum temperature progression, Heat effects: Adiabatic operations and non-adiabatic operations, Exothermic reactions in mixed flow reactors.

UNIT V

Residence time distribution of fluids in vessels, State of aggregation of the flowing systems, Earliness of mixing, Role of RTD, State of Aggregation and earliness of mixing in determining reactor behavior, E, F and C curves, Conversion in Non-ideal flow reactors.

BOOKS:

1. Levenspiel, O., “Chemical Reaction Engineering”, 3rd edition, John Wiley (1998).

ICH 606 **MASS TRANSFER OPERATION**

UNIT I

Mass Transfer and Diffusion: Steady-state ordinary molecular diffusion: Fick's law of diffusion; Velocities in mass transfer, Equimolar counterdiffusion; unimolecular diffusion, Diffusion coefficients: Diffusivity in gas mixtures, diffusivity in liquid mixtures, Diffusivity in solids, One-dimensional, steady-state, molecular diffusion through stationary media, Mass transfer in turbulent flow: Reynolds analogy; Chilton-Colburn analogy; Other analogies, Models for mass transfer at a fluid-fluid interface: Film theory; Penetration theory; surface-renewal theory; film-penetration theory, Two-film theory and overall mass transfer coefficients

UNIT II

Absorption and Stripping: Equipments, Gas-liquid equilibrium, Henry's law, Selection of solvent, Absorption in tray column, Graphical and analytical methods, Absorption in packed columns, HTU, NTU & HETP concepts, Design equations for packed column

UNIT III

Humidification and Dehumidification: Vapour-liquid equilibrium and enthalpy for a pure substance, vapour pressure temperature curve, Vapour gas mixtures, Definition and derivations of relationships related with humidity, Fundamental concept of humidification, Dehumidification and **W**ater cooling, Wet bulb temperature, Adiabatic and non-adiabatic operations, Evaporative cooling ,Classification and design of cooling towers.

UNIT IV

Drying: Solid-gas equilibrium, Different modes of drying operations, Definitions of moisture contents, Types of batch and continuous dryers, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying,

UNIT V

Crystallization: Crystal geometry-Crystal-size distribution; Thermodynamic considerations-Solubility and material balances, Enthalpy balance; Kinetic and transport considerations-Supersaturation, Nucleation, Crystal growth; Equipment for solution crystallization-Circulating, batch crystallizers, Continuous, cooling crystallizers, Continuous, vacuum evaporating crystallizers; MSMPR crystallization model-Crystal-population balance; Precipitation; Melt Crystallization-Equipment for melt crystallization; Zone melting.

BOOKS:

1. Treybal, R.E. "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
2. Seader, J.D. and Henley, E.J., "Separation Process Principles", 2nd ed., Wiley India Pvt. Ltd., New Delhi (2013).
3. Sherwood, T. K., Pigford, R. L. and Wilke, C.R. "Mass Transfer" McGraw Hill (1975).
4. Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th ed., PHI Learning Private Limited, New Delhi (2012).

ICH 653 INSTRUMENTATION AND PROCESS CONTROL LAB

1. Transient response to single tank system with storage & Flow to (a) step change (b) impulse change in put.
2. Transient response of non interacting system in series.
3. Transient response of interacting system in series.
4. Study the operation of ON-OFF electronic temperature controller & determination of its performance to control the temperature of a system having capacity to store thermal energy.
5. Transient response of a CSTR System to step change.
6. Study the dynamics of parallel & counter flow shell & tube heat exchanger.
7. Controlling of Parallel Flow & counter flow STHE using digital PI controller to have desired output.
8. Dynamics characteristics of mercury & water manometers.
9. Study of control value characteristics.
10. Study the performance of cascade control system & to maintain desired level in a tank, with flow.