Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)

(Under Maharashtra Act No. XXIX of 2014)

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Curriculum for Final year

B. Tech. in Chemical Engineering

With effect from AY 2023-24

	Semester VII									
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
			L	T	P	CA	MSE	ESE	Total	Cred
PCC	BTCHC701	Transport Phenomena	4	1	-	20	20	60	100	5
PCC	BTCHC702	Process Equipment Design and Drawing	4	-	-	20	20	60	100	4
PEC	BTCHE703	Professional Elective - IV	3	-	-	20	20	60	100	3
OEC	BTCHO704	Open Elective - IV	3	-	-	20	20	60	100	3
LC	BTCHL705	Process Instrumentation and Control Laboratory	-	-	3	60	-	40	100	2
LC	BTCHL706	Process Equipment Design, Drawing and Simulation Laboratory	-	-	3	60	-	40	100	2
Project	BTCHM707	Mini-Project - III	-	-	4	60	-	40	100	2
Internship	BTCHI708	Internship – 3 Evaluation	-	-	-	-	-	-	-	Audi
		Total	**14**	**1**	**10**	**260**	**80**	**360**	**700**	**21**
	Semester VIII									
Project/ Internship	BTCHP/ BTCHI - 801	Project work/ Internship	-	-	24	60	--	40	100	12
		Total	**-**	**-**	**24**	**60**		**40**	**100**	**12**

ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course

List of Electives

1) Professional Elective IV
   A. Mathematical methods in Chemical Engineering
   B. Membrane Technology
   C. Advanced Petroleum Refining
   D. Modeling and Simulation in Chemical Engineering
   E. Entrepreneurship Development
2) Open Elective IV
   A. Plant Utilities and Safety
   B. Corporate Communication

Semester VII

BTCHC701 Transport Phenomena

(5 credits)

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTCHC701	Transport Phenomena	4	1	-	20	20	60	100	5

Course Objective: After completion of course, students will have adequate background, conceptual clarity and knowledge of appropriate techniques related to:

1. Transport of momentum, transport of energy, mass transfer.
2. The transport of mass of various chemical species.
3. Create chemical engineering knowledge using the transport phenomena approach with special focus on combined transport problems.

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the analogy among momentum, heat and mass transport.
2. Formulate a mathematical representation of a flow/heat/mass transfer phenomena.
3. Solve flow/heat/mass transfer problems either individually or coupled for simple geometries analytically.
4. Identify the similarities among the correlations for flow, heat and mass transfer interfaces.
5. Create original solutions to fluid flow, heat transfer and mass transfer problems, and solve problems combining these transport phenomena.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	✓	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	-	✓	-	-	-	-	-	-
CO3	✓	-	✓	✓	-	✓	-	-	-	-	-	-
CO4	✓	-	✓	✓	-	✓	-	-	-	-	-	-

Detailed syllabus

UNIT I

1. **VISCOSITY AND MECHANISM OF MOMENTUM TRANSPORT :**Newton's Law of Viscosity; Non-Newtonian fluids ; The Bingham model; The power law model; The

Elli's model and the Reiner Philipp off model; Temperature and pressure dependents of viscosity.

2. **VELOCITY DISTRIBUTIONS IN LAMINAR FLOW:** Shell momentum balances; Boundary conditions ; Flow of a falling film; flow through a circular tube; flow through annulus.

UNIT II

1. EQUATION OF CHANGE FOR ISOTHERMAL SYSTEMS : Equations of continuity and motion in Cartesian and curvilinear co-ordinates; Use of the equations of change to set-up steady flow problems. Tangential annular flow of Newtonian fluid; Shape of surface of a rotating liquid.

2.VELOCITY DISTRIBUTIONS WITH MORE THAN ONE INDEPENDENT VARIABLE: Unsteady viscous flow ; Flow near a wall suddenly set in motion.

UNIT III

1. INTERPHASE TRANSPORT IN ISOTHERMAL SYSTEMS : Definition of fraction factors; Friction factors for flow in tubes; for around spheres.

2. **THERMAL CONDUCTIVITY AND MECHANISM OF ENERGY TRANSPORT :** Fourier's law of heat conduction; temperature and pressure dependence of thermal conductivity in gases and liquids

3. **TEMPERATURE DISTRIBUTIONS IN SOLIDS AND IN LAMINAR FLOW :** Shell energy balances; Boundary conditions; Heat conduction with an electrical heat source; with a viscous heat source.

UNIT IV

1. EQUATIONS OF CHANGE FOR NON-ISOTHERMAL SYSTEMS: Use of equations of energy and equations of motion (for forced and free convection) in non-isothermal flow; Tangential flow in an annulus with viscous heat generation; steady flow of a non-isothermal film; Transpiration cooling.

2. **TEMPERATURE DISTRIBUTIONS WITH MORE THAN ONE INDEPENDENT VARIABLE:** Unsteady heat conduction in solids; Heating of a semi-infinite slab.

3. **INTERPHASE TRANSPORT IN NON-ISOTHERMAL SYSTEMS :** Definition of heat transfer coefficient; Heat transfer coefficients for forced convection in tubes; for forced convection around submerged objects.

4. **DIFFUSIVITY AND THE MECHANISM OF MASS TRANSPORT :** definition of concentrations; Velocity and mass fluxes; Fick's law of diffusion; Temperature and pressure dependence of mass diffusivity.

UNIT V

1. CONCENTRATION DISTRIBUTION IN SOLIDS AND IN LAMINAR FLOW: Shell mass balances; Boundary conditions; Diffusion through a stagnant gas film; Diffusion with heterogeneous chemical reaction.

2. **EQUATION OF CHANGE FOR MULTICOMPONENT SYSTEMS:** Equations of continuity for a binary mixture.

3. **INTERPHASE TRANSPORT IN MULTICOMPONENT SYSTEMS:** Definition of binary mass transfer coefficients in one phase. Correlations of binary mass transfer coefficient in one phase at low mass transfer rates.

TEXT BOOK:

1. Bird R.B., Stewart W.E. and Light Foot E.N. Transport Phenomena – John Wiley International – 2nd Edition, New York, (2002).

REFERENCE BOOKS:

1. Christie J. Geankoplis – Transport Processes and Unit Operations – Prentice Hall of India Pvt. Ltd., New Delhi, 1997.

BTCHC702 Process Equipment Design and Drawing

(4 Credits)

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTCHC702	Process Equipment Design and Drawing	4	-	-	20	20	60	100	4

Course Objectives:

1. To learn the design procedure of various process equipment.
2. To understand the mechanical aspect of equipment design.
3. To understand the different types of code used in mechanical design of process equipment in chemical process industries.
4. To learn the design aspects of other component of process equipment.
5. To understand the relation between design, safety and environmental aspects.

Course Outcomes: At the end of the course, the student will be able to:

1. Identify equipment and instruments based on symbols
2. Draw process flow diagrams using symbols
3. Apply mechanical design aspects to process equipment
4. Design heat exchangers, evaporators, absorbers, distillation columns, reactors and filters.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	✓	-	-	✓	-	-	-	-	-	-	✓
CO2	-	✓	-	-	✓	-	-	-	-	-	-	-
CO3	✓	-	✓	✓	✓	✓	-	-	-	-	-	-
CO4	✓	-	✓	✓	✓	✓	-	-	-	-	-	-

Detailed syllabus

UNIT I:

Mechanical Design of Process Equipment: Introduction to mechanical aspects of chemical equipment design,

UNIT II:

Design Preliminaries, Design of cylindrical and spherical vessels under internal pressure, Design of heads and closers, Design of tall vessels.

UNIT III:

Drawing: Drawing of process equipment symbols for fluid handling, heat transfer, mass transfer, drawing of process equipment symbols for vessels, conveyers and feeders etc. Drawing of process equipment symbols for separators, mixing & comminution etc. Drawing of process equipment symbols for distillation, driers, evaporators, scrubbers etc.

UNIT IV:

Drawing of process equipment symbols for crystallizer, grinding, jigging, elutriation, magnetic separation, compressor etc. Drawing of basic instrumentation symbols for flow, temperature, level, pressure and combined instruments, Drawing of miscellaneous instrumentation symbols, detailed drawing of equipment, drawing of flow sheet.

UNIT V:

Process Equipment Design: Design of a heat exchanger, Design of an absorber, Design of a distillation column, Design of evaporator, Design of condenser, Design of a chemical reactor.

Text / References:

1. Brownell L.E, Process Equipment Design - Vessel Design, Wiley Eastern Ltd., 1986.
2. Bhattacharya B.C., Introduction to Chemical Equipment Design - Mechanical Aspects, CBS Publishers and Distributors, 2003.
3. Towler, G. P. and R. K. Sinnott, Chemical Engineering Design, Principles, Practice and Economics of Plant and Process Design, 2nd Edition, Butterworth Heinemann, 2012.
4. Donald Kern, Process Heat Transfer, 1st Edition, Tata McGraw-Hill Education, 1950

5. Robert E. Treybal, Mass-Transfer Operations, 3rd Edition, McGraw-Hill Book Company, 1981.

BTCHE703 Professional Elective – IV

(3 credits)

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PEC	BTCHE703	Professional Elective - IV	3	-	-	20	20	60	100	3

A. Mathematical Methods in Chemical Engineering

Course Objective:

1. The objective of this course is to introduce the student to analytical methods of solving linear algebraic, ordinary differential and partial differential equations.
2. The course will also cover numerical methods to solve algebraic and differential equations
3. To learn the methods used to solve the chemical engineering mathematical problems.

Course Outcomes: At the end of the course, the student will be able to:

1. Formulate lumped and distributed parameter mathematical models for chemical processes.
2. Calculate degrees of freedom for the developed mathematical models.
3. Solve the model equations describing chemical processes and equipment
4. Analyze the results of the solution methods

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	✓	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	-	-	-	-	-	-

Detailed Syllabus

UNIT I:

Mathematical Formulation of the Physical Problems- Introduction, Representation of the problem, blending process, continuous stirred tank reactor, Unsteady state operation, heat exchangers, distillation columns, biochemical reactors.

UNIT II:

Analytical (explicit) Solution of Ordinary Differential Equations encountered in Chemical Engineering Problems-Introduction, Order and degree, first order differential equations, second order differential equations, Linear differential equations, Simultaneous differential equations, .

UNIT III:

Formulation of partial differential equations- Introduction, Interpretation of partial derivatives,

Formulation partial differential equations, particular solutions of partial differential equations,

Orthogonal functions, Method of separation of variables, The Laplace Transform method,
Other transforms.

UNIT IV:

Unsteady state heat conduction in one dimension - Mass transfer with axial symmetry - Continuity equations; Boundary conditions - Iterative solution of algebraic equations- The difference operator - Properties of the difference operator- Linear finite difference equations-

UNIT V:

Non-linear finite difference equations- Simultaneous linear differential equations - analytical solutions - Application of Statistical Methods.

Text Books/ References:

1. Rice R. G. and D. Do Duong, 'Applied mathematics and modeling for chemical engineers'
   John Wiley & Sons, 1995.

2. Jenson J F and G. V. Jeffereys, 'Mathematical Methods in Chemical Engineering', Academic Press, 1977.
3. B. A. Finlayson, 'Introduction to Chemical Engineering Computing', Wiley India Edition, 2010
4. Singaresu S. Rao, 'Applied Numerical Methods for Engineers and Scientists', Prentice Hall, 2002.
5. Amiya K. Jana, Chemical Process Modelling and Computer Simulation, Prentice Hall India, 2nd Edition, 2011.

B. MEMBRANE TECHNOLOGY

Course Objective:

1. To gain the knowledge and understanding of all the membrane technology
2. To understand the need of various technologies related to membrane processess in chemical engineering.

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the technologies of membrane synthesis.
2. Classify the membranes.
3. Select membrane according to the application.
4. Understand and able to formulate and solve the mathematical models of membrane processes

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
CO2	-	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	-	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-

Detailed Syllabus

UNIT I:

Introduction: Membrane separation process, Definition of Membrane, Membrane types, Advantages and limitations of membrane technology compared to other separation processes, Membrane materials.

UNIT II:

Preparation of synthetic membranes: Phase inversion membranes, Preparation techniques for immersion precipitation, Synthesis of asymmetric and composite membranes, and Synthesis of inorganic membranes.

UNIT III:

Transport in membranes: Introduction, Driving forces, Transport through porous membranes, transport through non-porous membranes, Transport through ion-exchange membranes.

UNIT IV:

Membrane processes: Pressure driven membrane processes, Concentration as driving force, Electrically driven membrane processes

UNIT V:

Polarization phenomena and fouling: Concentration polarization, Membrane fouling Modules: Introduction, membrane modules, Comparison of the module configuration

Reference Books:

1. Mulder M, Basic Principles of Membrane Technology, Kluwer Academic Publishers, London, 1996.
2. Richard W. Baker, Membrane Technology and Research, Inc. (MTR), Newark, California, USA, 2004.
3. KaushikNath, Membrane Separation Processes, Prentice-Hall Publications, New Delhi, 2008.

C. Advanced Petroleum Refining

Course Objective:

1. This course reviews the fundamentals of secondary and finishing refining processes as well as covers advanced concepts of refineries processes.
2. Understand different refinery processes.
3. Understand secondary gasoline manufacturing processes

Course Outcomes: At the end of the course, the student will be able to:

1. To understand secondary refining processes for light and middle distillates and to analyse the application of these for different refining scenarios
2. To understand and evaluate various residue processing schemes.
3. To apply the finishing processes to petroleum products for meeting the market specifications in view of fuel quality and environmental regulations.
4. Evaluate and compare different processes

Detailed Syllabus:

UNIT I

Coking and thermal processes- Types, properties and uses of petroleum coke, process description for delayed coking and fluid bed coking, case study problem.

UNIT II

Catalytic cracking– Fludized bed catalytic cracking, New design of FCC units, cracking reactions, Coking of cracking catalyst, process variables, heat recovery, yield estimation, capital and operating cost, case study problem on catalytic cracker.

Catalytic Hydrocracking- Hydrocracking reactions, feed preparation, process description, hydrocracking catalyst, process variables, hydrocrcking yield, investment and operating cost, case study problem on hydrocracker.

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UNIT III

Hydroprocessing and residprocessing- Composition of vacuum tower bottoms, process options, hydroprocessing, expanded bed hydrocracking processes, moving bed hydroprocessors, solvent extraction, summary of resid processing operations.
Hydrotreating- Hydrotreating catalyst, aromatic reduction, reactions, process variables, construction and operating cost, case study problem on hydrotreator.

UNIT IV

Catalytic reforming and isomerization- Feed preparation, catalytic reforming processes, reforming catalysts, reactor design, yields and costs.
Isomerization – Capital and operating costs, isomerization yield, case study problem on
Reformer and isomerization unit.

UNIT V

Alkylation and polymerization– Alkylation reactions, process variables, alkylation feed stocks, alkylation products, HF and sulfuric acid alkylation process, comparison between the processes, alkylation yields and costs, co-polymerization , case study problem on alkylation and polymerization.

Reference Book:

1. J. H. Gary, "Petroleum Refining - Technology and Economics" 3rd Ed., Marcel DekkarInc, 1994
5. 2. G. D. Hobson, "Modern Petroleum Technology" Vol. I & II, 5th Ed., Applied Science, London

D.MODELING AND SIMULATION IN CHEMICAL ENGINEERING

Course Outcomes: At the end of the course, students will be able to:

CO 1	use mass balance, component balance, energy balance and momentum balance equations for mathematical model development.
CO2	to develop lumped parameter mathematical models of heat transfer, mass transfer equipments and reactors with heat transfer.
CO3	to develop distributed parameter models of mass transfer equipments, heat exchangers and plug flow reactors.
CO4	to use basic features of modern simulation software.

Mapping of Course outcomes with Program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1	✓										✓	✓
CO 2	✓	✓									✓	✓
CO 3	✓	✓	✓		✓						✓	✓
CO 4			✓		✓						✓	✓

Unit 1: Basic Modeling Introduction to modeling – Types of Models, Dependent & Independent Variables, Application and scope coverage, Modeling fundamentals, Chemical engineering modeling, Several aspects of the modeling approach, General modeling procedure

Unit 2: Formulation of dynamic models Mass balance equation - Balancing procedure, Case studies: CSTR, Tubular reactor , Coffee percolator, Total mass balance, Case Studies: Tank drainage, Component balances Case Studies: Waste holding tank, Continuous heating in an agitated tank, Heating in a filling tank, Parallel reaction in a semi continuous reactor with large temperature difference, Momentum balances – Dimensionless model equations, CSTR, Gas liquid mass transfer in a continuous reactor, Multistage Evaporator

Unit 3: Modeling of stage wise processes Introduction, Stirred tank reactor, Reactor Configurations, Generalized model description, Heat transfer to and from reactors, Steam heating in jacket, Dynamics of the metal jacket walls, Batch reactor – Constant volume, Semi - Batch reactor, CSTR - Constant volume CSTR, CSTR cascade, Reactor stability, Reactor Control, Bioreactors, Trickle bed reactor

Unit 4: Mass transfer process models Liquid-liquid extraction, Binary batch distillation, Continuous binary distillation, Multi-component separation, Multi-component steam distillation, Absorber- stage wise absorption, steady state gas absorption with heat effects.

Unit 5: Modeling of distributed system Plug flow tubular reactor, Liquid phase tubular flow reactor, Gas phase tubular flow reactor contactors, Dynamic simulation of the Plug-Flow tubular reactor , Dynamic modeling of plug-flow contactors: liquid–

liquid extraction column dynamics, Steady-state tubular flow with heat loss, Steady state counter-current heat exchanger, Heat exchanger dynamics

Unit 6: Process Simulation Scope of process simulation, Formulation of problem, Step for steady state simulation, Process simulation approaches for steady state simulation, Strategies, Process simulator, Structure of process simulator, Integral process simulation, Demonstration of process simulator

Text / References:

1. W. L. Luyben, ―Process Modeling, Simulation and Control for Chemical Engineering, McGraw Hill Book co., 1973.

2. John Ingham, Irving, J. Dunn, Elmar, Heinzle Jiri, E. Prenosil, ―Chemical Engineering Dynamics, VCH Publishers Inc., New York, 1974.

3. Amiya K. Jana, Chemical Process Modelling and Computer Simulation, Prentice Hall India, 2nd Edition, 2011.

E. Entrepreneurship Development

Course Objective:

1. Understand entrepreneurship and entrepreneurial process and its significance in economic development.
2. Understand the stages of establishment, growth, barriers, and causes of sickness in industry to initiate appropriate strategies for operation, stabilization and growth.

Course Outcomes: At the end of the course, the student will be able to:

1. Develop an idea of the support structure and promotional agencies assisting ethical entrepreneurship.
2. Identify entrepreneurial opportunities, support and resource requirements to launch new venture within legal and formal frame work
3. Develop a framework for technical, economic and financial feasibility.
4. Evaluate an opportunity and prepare a written business plan to communicate business ideas effectively.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	-	-	-	-	-	-	-	-	✓	✓	✓	-
CO2	-	-	-	-	-	-	-	-	✓	✓	✓	-
CO3	-	-	-	-	-	-	-	-	✓	✓	✓	-
CO4	-	-	-	-	-	-	-	-	✓	✓	✓	-

Detailed Syllabus:

UNIT I:

Entrepreneur and Entrepreneurship: Introduction; Entrepreneur and Entrepreneurship; Role of entrepreneurship in economic development; Entrepreneurial competencies and motivation; Institutional Interface for Small Scale Industry/Enterprises.

UNIT II:

Establishing Small Scale Enterprise: Opportunity Scanning and Identification; Creativity and product development process; Market survey and assessment; choice of technology and selection of site.

UNIT III:

Planning Small Scale Enterprises: Financing new/small enterprises; Techno Economic Feasibility Assessment; Preparation of Business Plan; Forms of business organization/ownership.

UNIT IV:

Operational Issues in SSE: Financial management issues; Operational/project management issues in SSE; Marketing management issues in SSE; Relevant business and industrial Laws.

UNIT V:

Performance appraisal and growth strategies: Management performance assessment and control; Causes of Sickness in SSI, Strategies for Stabilization and Growth.

References:

1. G.G. Meredith, R.E.Nelson and P.A. Neek, The Practice of Entrepreneurship, ILO, 1982.
2. Dr. Vasant Desai, Management of Small Scale Enterprises, Himalaya Publishing House,
2004.
3. A Handbook for New Entrepreneurs, Entrepreneurship Development Institute of India,
Ahmadabad 1988.

4. Bruce R Barringer and R Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, 3rd ed., Pearson Edu., 2013.

BTCHO704 Open Elective – IV

(3 credits)

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
OEC	BTCHO704	Open Elective – IV	3	-	-	20	20	60	100	3

A. Plant Utilities and Safety

Course Objective:

1. To gain knowledge about different process utilities used in the chemical process industry.
2. To understand the issues related to hazards & safety.
3. To gain the knowledge of about the effective utilization of process utilities, like water, steam, air and refrigerants.

Course Outcomes: At the end of the course, the student will be able to:

1. List utilities in a plant.
2. Understand properties of steam and operation of boilers for steam generation
3. Understand refrigeration methods used in industry
4. Compare power generation methods
5. Classify and describe the types of water, water treatment methods, storage and distribution techniques

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	✓	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	✓	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	✓	-	-	-	-	-	-
CO4	✓	-	✓	✓	-	✓	-	-	-	-	-	-
CO5	✓	-	✓	✓	-	✓	✓	-	-	-	-	-

Detailed syllabus

UNIT I:

Identification of common plant utilities: water, compressed air, steam, vacuum, refrigeration, venting, flaring and pollution abating. Water and its quality, storage and distribution for cooling and fire fighting.

UNIT II:

Steam generation by boilers: Types of boilers and their operation, Steam generation by utilizing process waste heat using thermic fluids, Distribution of steam in a plant.

Principles of refrigeration: Creation of low temperature using various refrigerants. Creation of low pressure/vacuum by pumps and ejectors.

UNIT III:

Safety in Chemical Processes: Introduction, Chemical Process classification, Process design and safety parameters. Safety parameters in the process design of phenol from cumene, safety in polyvinyl chloride plant.

Chemicals and their Hazards: Introduction, Acetonitrile, acetyl chloride, butyl amine, acrylamide, acrylonitrile, allyl alcohol, benzene, bromine, isopropyl alcohol, acetaldehyde, ethylene oxide, butane, n-hexane, anhydrous ammonia, acetone, toluene, p-xylene, acetic acid, monochloro benzene, oleum, carbon mon

UNIT IV:

Hazards in Chemical Process plants: Introduction, Hazards, Hazard code and explosive limit, electrical safety in chemical process plants, static electricity hazards, pressure vessel hazards, LEL and UEL of various compounds, explosive hazard, flammable liquid hazards, protection to storage tanks, fire zone location, fireball, fireball hazard. Safety in handling gases, liquids and solids: Introduction, safety in handling of gases, chlorine hazards, chlorine leakage management, safety in handling of fluorine, important safety considerations in ammonia storage, flammable solids storage, flammable liquid storage, handling of LNG, requirements to be fulfilled for storing hydrocarbons or chemicals, fail safe concept, transportation of hazardous chemicals, Hazardous in plastics processing.

UNIT V:

Combating Chemical Fires: Classification of fires, control of high vaour pressure fire, fire fighting foams, foam for fire protection, Foam characteristics, gaseous agent extinguishing system, automatic sprinkler system, chemical extinguishing powders, natural gas fire control. Portable fire extinguishers: Soda-acid extinguishers, carbon dioxide extinguisher, dry chemical fire extinguisher, general safety precautions for maintenance of fire extinguishers.

Safety Checklist: safety studies for chemical plants, safety checklist during startup, safety checklist during shutdown mode, safety checklist for installation, safety needs during construction. Protective devices.

Text / Reference:

1. D. A. Wangham, Theory and practice of Heat engines, ELBS cambridge University press, 1970.
2. J. L. Threlkeld, Thermal Environmental Engineering, Prentic Hall 1970.
3. S.D.Dawande, Chemical Hazards and safety, Dennet& Co publishers, 2007

B. Corporate Communication

Course Objective:

1. To understanding of what corporate communication is, what its role in corporations is, and the different perspectives on corporate communication.
2. To understand key theories of corporate communication and public relations.
3. To know key concepts of corporate communications and public relations (DLO 1).

Course Outcomes: At the end of the course, students will be able to:

1. Understand corporate communication culture.
2. Prepare business letters, memos and reports.
3. Communicate effectively in formal business situations.
4. Exhibit corporate social responsibility and ethics.
5. Practice corporate email, mobile and telephone etiquette.
6. Develop good listening skills and leadership qualities.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	✓	✓	✓	-
CO2	-	-	-	-	-	-	-	-	✓	✓	✓	-
CO3	-	-	-	-	-	-	-	-	✓	✓	✓	-
CO4	-	-	-	-	-	-	-	-	✓	✓	✓	-
CO5	-	-	-	-	-	-	-	-	✓	✓	✓	-
CO6	-	-	-	-	-	-	-	-	✓	✓	✓	-

Detailed Syllabus:

UNIT I:

Importance of Corporate communication: Introduction to and definition of corporate – Communication, process, patterns and channels of communication- Barriers to communication and strategies to overcome them- Evolution of corporate culture- Role and contribution of individual group and organization - Role of psychology in communication.

UNIT II:

Oral Communication: Techniques for improving oral fluency-Speech mechanics-Group Dynamics and Group Discussion – Debate and oral presentations. Written Communication: Types and purposes- Writing business reports, and business proposals-Memos, minutes of meetings- Circulars, persuasive letters- Letters of complaint- ; language and formats used for drafting different forms of communication. Internal and external communication.

UNIT III:

Corporate responsibility: Circulating to employees' vision and mission statements- ethical practices- Human rights -Labor rights-Environment-governance- Moral and ethical debates surrounding -Public Relations - Building trust with stakeholders.

UNIT IV:

Corporate Ethics and Business Etiquette: Integrity in communication-Harmful practices and communication breakdown- Teaching how to deal with tough clients through soft skills. Body language- Grooming- Introducing oneself- Use of polite language- Avoiding grapevine and card pushing – Etiquette in e-mail, mobile and telephone.

UNIT V:

Listening Skills: Listening- for information and content- Kinds of listening- Factors affecting listening and techniques to overcome them- retention of facts, data and figures- Role of speaker in listening.Leadership Communication Styles: Business leadership -Aspects of leadership-qualities of leader- training for leadership-delegation of powers and ways to do it-humour-commitment.

Text / References:

1. Raymond V. Lesikar, John D. Pettit, Marie E. FlatleyLesikar's Basic Business Communication - 7th Edition: Irwin, 1993

2. Krishna Mohan and MeeraBanerji, Developing Communication Skills: Macmillan Publishers India, 2000

3. R.C. Sharma & Krishna Mohan Business Correspondence and Report Writing: – 3rd Edition Tata McGraw-Hill, 2008

4. Antony Jay & Ross Jay, Effective Presentation, University Press, 1999.

5. Shirley Taylor, Communication for Business, Longman, 1999

BTCHL705 Process Instrumentation and Control Lab

(2 credits)

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
LC	BTCHL705	Process Instrumentation and Control Lab	-	-	3	60	-	40	100	2

Course Objective:

1. To make students aware of working of Different process control instruments through hands-on training.
2. To make students to correlate theory and practical process control through principles, 2fundamental concepts and by experimentation.

Course Outcomes: At the end of the course, the student will be able to:

1. Calculate the characteristics of control valves.
2. Determine the dynamics of level and temperature measurement process.
3. Determine the dynamics of two capacity liquid level process without interaction and with interaction, U-tube manometer.
4. Determine the performance of controllers for a flow process, pressure process, level process, temperature process.
5. Evaluate the performance of cascade control.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	-	-	-	-	-	-

CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO5	✓	✓	✓	✓	✓							

List of Experiments:

1. To determine the time constant of given thermometer with positive step change.
2. To determine the time constant of given thermometer with negative step change.
3. To determine the time constant and valve properties of single tank system.
4. To study the step response of two tank non-interacting liquid level system and compare the observed transient response with the theoretical transient response.
5.. To study the step response of two tank interacting liquid level system and compare the observed transient response with the theoretical transient response for the condition $T_1=T_2=T$.
6. To study the impulse response of a tank.
7. To study coupled three or four tanks system.
8. To study any inherently second order system.
9. To study different types of controllers.

BTCHL706 Process Equipment Design, Drawing and Simulation Laboratory (2 credits)

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
LC	**BTCHL706**	**Process Equipment Design and Drawing Laboratory**	**-**	**-**	**3**	**60**	**-**	**40**	**100**	**2**

Course Objective:

1. To learn how to use and draw basic Standard equipment symbols and Standard instrumentation symbols used in the chemical process industry.

2. To study how to design and draw Heads and closures, Keys and couplings, Supports for vessels- like Bracket Support, Leg Support, Skirt Support and packed absorption tower.
3. Learn to draw the process flow diagram using symbols.

4. Learn to design heat exchangers, evaporators, absorbers, distillation columns, reactors, filters etc

Course Outcomes: At the end of the course, the student will be able to:

1. Identify equipment and instruments based on symbols.
2. Draw process flow diagrams using symbols.
3. Apply mechanical design aspects to process equipment.
4. Design heat exchangers, evaporators, absorbers, distillation columns, reactors , filters etc.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-

List of Experiments :

- Based on the theory course students should design and draw the sheets of chemical process vessels.
- General Concepts of Simulation for Process Design: Introduction; Process simulation models; Methods for solving non-linera equations; Recycle partitioning and tearing; Simulation examples.
  Design of following equipment using ASPENPLUS or any good software

  a. Heat Exchanger

  b. Absorption column

  c. Distillation column

  d. Reactor

  e. Evaporator

  f. Flow sheeting of a chemical plant

  g. Simulation of a small size chemical plant.

BTCHM707 Mini Project III

2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Project	BTCHM 707	Mini Project – III	-	-	4	60	-	40	100	2

The purpose behind the mini project is that the student should be exposed to more hands-on rather than merely theory. It is expected that the student (or a small group say, not more than two in a group, to be confirmed) will undertake to make a working model, a program, etc. which he/she will benefit from since he /she will be doing it first-hand.

BTCHI708 Internship – 3 (Evaluation)

Audit

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Internship	BTCHI708	Internship - 3 (Evaluation)	-	-	-	-	-	-	-	Audit

Course Outcomes: At the end of the course, the student will be able to:

1. Acquire knowledge on topics outside the scope of curriculum on summer training.
2. Communicate with group of people on different topics of summer training.
3. Collect and consolidate required information on a topic of summer training.
4. Prepare a seminar report on summer training

Each student is expected to spend Four weeks in any one factory/project/workshop at the end of sixth semester (during summer vacation). Here he/she shall observe layout, working and use of various machinery, plants, design, instruments, process etc. under the general supervision of the foreman/artisan/engineer of the factory etc.

The student shall submit the report in a systematic technical format about the major field of the factory, particularly about the section/department where he/she has

received the training giving details of equipment, machinery, materials, process etc. with their detailed specifications, use etc. The report shall be checked and evaluated by the concerned teacher and appropriate grade shall be awarded.

Semester VIII

BTCHP 801/BTCHI 801 Project/Internship

12 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Project/Internship	BTCHP801/ BTCHI801	Project work/Internship	-	-	24	60	-	40	100	12

Every student will have to do Project Work or Internship for the whole semester. The student can choose area suitable to him/her and should devote full semester for the project work or internship assigned to him/her either in industry or institution. The work will be continuously monitored by the Guide/s assigned to him/her. The student has to prepare/submit reports and do presentations as per the rules framed by the University/department from time to time.