Hindustan College of Science and Technology
Farah-Mathura
(AICTE approved & affiliated to AKTU)

NAAC
CRITERIA-2

Metric No.- 2.6.1 (Q_IM)

Programme Outcomes (POs) and Course Outcomes (COs) for Chemical Engineering

B.TECH (CHEMICAL ENGINEERING)

SEMESTER- III

Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KOE031-38/ KAS302	Engineering Science Course/Maths IV	3	1	0	30	20	50		100		150	4
2	KAS301/ KVE 301	Technical Communication/Universal Human values	2 3	1 0	0 0	30	20	50		100		150	3
3	KCH301	Material and Energy Balance	3	1	0	30	20	50		100		150	4
4	KCH302	Chemical Engineering Fluid Mechanics	3	1	0	30	20	50		100		150	4
5	KCH303	Heat Transfer Operations	3	0	0	30	20	50		100		150	3
6	KCH351	Chemical Engineering Fluid Mechanics Lab	0	0	2				25		25	50	1
7	KCH352	Heat Transfer Operations Lab	0	0	2				25		25	50	1
8	KCH353	Soft Computing Lab	0	0	2				25		25	50	1
9	KCH354	Mini Project or Internship Assessment*	0	0	2			50				50	1
10	KNC301/ KNC302	Computer System Security/Python Programming	2	0	0	15	10	25		50			0
11		MOOCs (Essential for Hons. Degree)											
		Total										**950**	**22**

*The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.

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SEMESTER- IV													
Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KAS402/ KOE041-48	Maths IV/Engineering Science Course	3	1	0	30	20	50		100		150	4
2	KVE401/ KAS401	Universal Human Values/ Technical Communication	3 2	0 1	0 0	30	20	50		100		150	3
3	KCH401	Mechanical Operations	3	0	0	30	20	50		100		150	3
4	KCH402	Chemical Reaction Engineering-I	3	1	0	30	20	50		100		150	4
5	KCH403	Chemical Engineering Thermodynamics	3	1	0	30	20	50		100		150	4
6	KCH451	Mechanical Operations Lab	0	0	2				25		25	50	1
7	KCH452	Chemical Reaction Engineering Lab	0	0	2				25		25	50	1
8	KCH453	Numerical Methods of Analysis Lab	0	0	2				25		25	50	1
9	KNC402/ KNC401	Python Programming/Computer System Security	2	0	0	15	10	25		50			0
10		MOOCs (Essential for Hons. Degree)											
		Total										**900**	**21**

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DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOWB.TECH III YEAR V SEMESTER CHEMICAL ENGINEERING

SEMESTER- V													
Sl. No	**Subject Codes**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	BCH 501	Mass Transfer -I	3	1	0	30	20	50		100		150	4
2	BCH 502	Chemical Reaction Engineering - II	3	1	0	30	20	50		100		150	4
3	BCH 503	Process Dynamics and Control	3	1	0	30	20	50		100		150	4
4	BCH 051-054	Departmental Elective-I	3	0	0	30	20	50		100		150	3
5	BCH 055-058	Departmental Elective-II	3	0	0	30	20	50		100		150	3
6	BCH551	Mass Transfer-I Lab	0	0	2				25		25	50	1
7	BCH 552	PDC Lab	0	0	2				25		25	50	1
8	BCH 553	Process Modelling and Simulation Lab	0	0	2				25		25	50	1
9	BCH555	Mini Project or Internship Assessment*	0	0	2				50			50	1
10	BNC501/ BNC502	Constitution of India / Essence of Indian Traditional Knowledge	2	0	0	15	10	25		50			
11		MOOCs (Essential for Hons. Degree)											
		Total	**17**	**3**	**8**							**950**	**22**

*The Mini Project or internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.

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DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOWB.TECH III YEAR VI SEMESTER CHEMICAL ENGINEERING

SEMESTER- VI												SESSION 2020-21	
Sl. No	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	BCH 601	Mass Transfer -II	3	1	0	30	20	50		100		150	4
2	BCH 602	Transport Phenomenon	3	1	0	30	20	50		100		150	4
3	BCH 603	Chemical Technology	3	1	0	30	20	50		100		150	4
4	BCH 061-064	Departmental Elective-III	3	0	0	30	20	50		100		150	3
5		Open Elective-I [Annexure - B(iv)]	3	0	0	30	20	50		100		150	3
6	BCH 651	Chemical Technology Lab	0	0	2				25		25	50	1
7	BCH 652	Mass Transfer-II Lab	0	0	2				25		25	50	1
8	BCH 653	Technical Presentation	0	0	2				25		25	50	1
9	BNC601/ BNC602	Essence of Indian Traditional Knowledge/ Constitution of India	2	0	0	15	10	25		50			
10		MOOCs (Essential for Hons. Degree)											
		Total	**0**	**3**	**6**							**900**	**21**

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Department: Chemical Engineering
Course Outcomes COs-B.Tech 2nd,3rd & 4th Year
Batch: 2023-24

B.Tech 3rd Semester

Subject Name	Subject Code	Course Outcomes of the Subject	
Engineering Science	BOE303	CO1	Understand the properties of polymers, types and mechanism of polymerization.
		CO2	Understand and apply the various processing and manufacturing techniques, high performance polymer and polymer composites.
		CO3	Understand the preparation, properties and technical applications of polymers.
		CO4	Understand the applications of different polymeric materials in current scenario of development.
		CO5	Understand the concept of polymer synthesis, Functionality, Crystallinity, Calculation of average molecular weight
Technical Communication	BAS301	CO1	Students will be able to UNDERSTAND the nature and objective of Technical Communication relevant for the work place as Engineers.
		CO2	Students will be able to DEVELOP an understanding of key concepts of writing, designing and speaking.
		CO3	Students will be able to UTILIZE the technical writing skills for the purposes of Technical Communication and its exposure in various dimensions.
		CO4	Students will be able BUILD UP interpersonal communication traits that will make the transition from institution to workplace smoother and help them to excel in their jobs.
		CO5	Students will be able to APPLY technical communication to build their personal brand and handle crisis communication.
Material and Energy Balance	BCH301	CO1	Understand conversions of units, equations, and various concentration measures
		CO2	Carry out combustion calculations, proximate and ultimate analysis.
		CO3	Apply steady-state and unsteady-state material and energy balance on a system.
		CO4	Analyze all the stoichiometric relations being applied to a system undergoing a chemical process and perform the enthalpy calculation.
		CO5	Design equipment with inlet and outlet; including recycle-bypass streams for a chemical process and calculate the quantities of utilities required.
Chemical Engineering Fluid Mechanics	BCH302	CO1	Understand the properties and flow of fluid.
		CO2	Explain the factors influencing velocity profiles for laminar and turbulent flow.

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		CO3	Analyze the model and prototype.
		CO4	Understand and solve incompressible viscous flow problems.
		CO5	Design the pumps and compressors for optimum operation.
Heat Transfer Operations	**BCH303**	CO1	Acquire fundamental knowledge of the numerous modes of heat transfer and a thorough understanding of heat conduction.
		CO2	Understand the convection phenomenon and use them to solve problems.
		CO3	Determine radiation heat transfer involving various geometries by applying the applicable laws.
		CO4	Formulating the equations pertaining to boiling and condensation phenomena, subsequently employing them to solve relevant problems.
		CO5	Design heat exchangers and evaporators and evaluate their performance.
Chemical Engineering Fluid Mechanics Lab	**BCH351**	CO1	Calculate coefficient of discharge through v-notch, venture meter, and orifice meter
		CO2	Determine friction losses through different pipes and fittings.
		CO3	Calculate the efficiency of centrifugal pump.
		CO4	Study different types of flow and analyze Bernoulli's law.
Heat Transfer Operations Lab	**BCH352**	CO1	Determine the thermal conductivity of different materials.
		CO2	Determine the heat transfer coefficient for natural and forced convection and the rate of heat transfer.
		CO3	Acquire an understanding of the radiation heat transfer process
Numerical Methods of Analysis Lab	**BCH353**	CO1	Compare the computational methods for advantages and drawbacks,
		CO2	Implement the computational methods using any of the existing programming languages, test such methods, and compare between them,
		CO3	Identify the suitable computational technique for a specific type of problem and develop the computational method that is suitable for the underlying problem.
B.Tech IV Semester			
Math IV	**BAS402**	CO1	The idea of partial differential equation and its different types of solution.
		CO2	The concept ofmethod of separation of variables and Fourier transform to solve partial differential equations.
		CO3	The basic ideas of statistics including measures of central tendency, correlation, regression and their properties.
		CO4	The idea of probability, random variables, discrete and continuous probability distributions and their properties.
		CO5	The statistical methods of studying data samples, hypothesis testing and statistical quality control.
Universal Human Value and Professional Ethics	**BVE401**	CO1	Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content, and process of value education

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		CO2	Distinguish between the Self and the Body, and understand the meaning of Harmony in the Self and the Co-existence of Self and Body.
		CO3	Understand the value of harmonious relationships based on trust, respect, and other naturally acceptable feelings in human
		CO4	Understand the harmony in nature and existence, and workout their mutually fulfilling participation in nature.
		CO5	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work
Chemical Reaction Engineering-I	**BCH401**	CO1	Identify the reaction type and their kinetics.
		CO2	Design the reactor for the batch and continuous chemical process.
		CO3	Design of Multiple Reactors.
		CO4	Understand Non – isothermal Reactors.
		CO5	Understand the Ideal and Non–Ideal Reactors.
Chemical Engineering Thermodynamics	**BCH402**	CO1	Identify the thermodynamic property of the pure substance and mixture.
		CO2	Know the basic principles of refrigeration and liquefaction process.
		CO3	Understand the relation between thermodynamic and chemical reactions
Mechanical Operations	**BCH403**	CO1	Demonstrate knowledge of size reduction and size enlargement, and examine their performance using applicable legal principles.
		CO2	Analyze and implement the principles of particle size analysis, screening apparatus types, and sedimentation and elutriation techniques.
		CO3	Explain the concept of Particle Separation and various Particle Separation Approaches
		CO4	Analysis, fluidization, and filtration, and demonstrate the concept of their respective applications.
		CO5	Demonstrate knowledge of agitation, and mixing, in addition to the storage and conveying of solids.
Chemical Reaction Engineering Lab	**BCH451**	CO1	Analyze the reaction type and their kinetics.
		CO2	Design the reactor for the batch and continuous chemical processes.
		CO3	Study and operation of adiabatic rector.
Mechanical Operations Lab	**BCH452**	CO1	Estimate the crushing efficiency and measure the particle size.
		CO2	Calculate the medium and filter resistance of filters.
		CO3	Explain the particle separation process.
Soft Computing Lab	**BCH453**	CO1	Understand the importance and application of software.
		CO2	Solve basic chemical engineering problems using suitable software (MS-EXCEL, MATLAB, Aspen Plus, etc.).
Python Programming	**BCC402**	CO1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.

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		CO2	Express proficiency in the handling of strings and functions
		CO3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.
		CO4	Identify the commonly used operations involving file systems and regular expressions.
		CO5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python
Sports and Yoga - II	**BVE451**	CO1	To maintain their mental and physical wellness upright and develop ability in them to cope up with the stress arising in the life.
		CO2	To create space in the curriculum to nurture the potential of the students in sports/games/yoga etc.
		CO3	To take forward the previous course on the topic to next advance level in terms of practice and specialization
B.Tech V Semester			
Mass Transfer-I	**BCH501**	CO1	Demonstrate a clear understanding of the fundamental concepts of mass transfer, including diffusion, mass transfer coefficients
		CO2	Analyze and solve problems related to mass transfer operations like distillation
		CO3	Analyze the absorption phenomenon using both theoretical and empirical approaches
		CO4	Design and optimize simple equilibrium-staged separation processes, such as binary distillation and absorption columns, considering energy efficiency and cost
		CO5	Calculate mass transfer rates in various systems and determine mass transfer coefficients using appropriate correlations and experimental data
		CO6	Analyze the drying phenomenon
Chemical Reaction Engineering – II	**BCH502**	CO1	Understand the fundamentals of homogeneous and heterogeneous reactions, including catalyst selection and deactivation.
		CO2	Analyze adsorption mechanisms, catalytic reaction mechanisms, and their impact on chemical equilibrium.
		CO3	Explore solid-catalyzed reactions, focusing on pore diffusion resistance, surface kinetics, and reactor performance equations.
		CO4	Evaluate fluid-solid reactions using models like the shrinking core model and determine rate-controlling steps
		CO5	Study fluid-fluid reaction kinetics, mass transfer, and reactor design based on contactor types and patterns.
Process Dynamics & Control	**BCH503**	CO1	Demonstrate fundamental understanding of process control.
		CO2	Develop transfer function (input-output) and models for linear dynamic processes.
		CO3	Characterize the dynamics and stability of processes based on mathematical analysis.

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		CO4	Develop the mathematical model of various chemical processes.
		CO5	Understand different control modes and their application in controlling various processes and the working of different controllers and valves.
Mass Transfer-I Lab	**BCH 551**	CO1	Understand the principles of molecular diffusion and basic laws of mass transfer
		CO2	Utilize mass transfer concepts to design gas absorption systems.
		CO3	Understand the basics of all types of distillation process and its application
		CO4	Apply the concept and mechanism of drying operations
		CO5	Understand the concept of the crystallization process
PDC Lab	**BCH 552**	CO1	Demonstrate fundamental understanding of process control.
		CO2	Develop transfer function (input-output) and models for linear dynamic processes.
		CO3	Characterize the dynamics and stability of processes based on mathematical analysis.
		CO4	Develop the mathematical model of various chemical processes.
		CO5	Understand different control modes and their application in controlling various processes and the working of different controllers and valves.
Process Modeling & Simulation Lab	**BCH 553**	CO1	Understand the fundamentals of process modeling and simulation, including key concepts and techniques.
		CO2	Apply MATLAB to solve process modeling problems and simulate chemical processes.
		CO3	Gain proficiency in using Aspen Plus/CHEMCAD for simulating individual equipment and analyzing VLE data.
		CO4	Design and optimize distillation columns, evaporators, and heat exchangers using simulation tools.
		CO5	Simulate absorption, reaction, and diffusion processes in various reactors using a two-film model.
Numerical Methods for Chemical Engineer	**BCH 053**	CO1	Solve the equations with first order and first degree with linear coefficients.
		CO2	Understand and solve unsteady state problems.
		CO3	Provide the solution of various types of equations.
		CO4	Solve linear and non-linear algebraic equations using numerical method
		CO5	Apply the above-mentioned strategies solving Chemical engineering problems
Intellectual Property Rights &Standardization	**BCH 058**	CO1	Adequate knowledge on patent and copyright for their innovative research works
		CO2	During their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search.
		CO3	Developing their idea or innovations
		CO4	Pave the way for the students to catchup Intellectual Property as a career-option

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		CO5	Understand Bharat Stage emission and standards (BS)
B.Tech VI Semester			
Mass Transfer-II	**BCH601**	CO1	To provide students with a comprehensive understanding of the principles and applications of liquid-liquid extraction and leaching processes in separating components from mixtures.
		CO2	To introduce students to the fundamentals of adsorption, including types of adsorbents, adsorption isotherms
		CO3	To impart knowledge on humidification, and types of various humidifiers and dehumidifiers
		CO4	To familiarize students with the concepts of crystallization, crystal growth, nucleation, and the design and operation of crystallizers for industrial applications.
		CO5	To teach students the design, analysis, and optimization of mass transfer equipment for liquid-liquid extraction, leaching, adsorption, humidification, and crystallization
Transport Phenomena	**BCH602**	CO1	Understand and apply the shell balance for fluid flow problems
		CO2	Apply the Navior-stokes equation for fluid flow problems
		CO3	Formulate problems of heat transfer in laminar flow
		CO4	Apply energy equation for various conditions
		CO5	Formulate the problems of mass transfer in laminar flow
Chemical Technology	**BCH603**	CO1	Understand the principles and symbols used in process flow diagrams and their application in various industrial processes
		CO2	Explain the production methods and applications of key chemicals and by-products in the chlor-alkali and sulphur industries.
		CO3	Describe the processes involved in the production of cement, fuel gases, and industrial gases, including producer gas, syn gas, and nitrogen.
		CO4	Analyze the manufacturing processes of phosphorus, phosphoric acid, and nitrogenous fertilizers, and evaluate their role in agriculture
		CO5	Discuss the chemical processes for producing bio-fertilizers, pesticides, and the technology behind soap, detergents, and other oil-based products.
Chemical Technology Lab	**BCH 651**	CO1	Understand the processes involved in the preparation of Turkey Red Oil and its applications in the leather industry
		CO2	Analyze the formulation and production techniques for dry/oil-bound distemper and cement paint
		CO3	Explore the manufacturing processes of liquid soap, transparent soaps, and detergent powder.
		CO4	Study the preparation of alkyd resin and its applications in coatings and paints.
		CO5	Gain insights into the processes of oil extraction, splitting, and margarine production

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Mass Transfer-II Lab	**BCH 652**	CO1	Analyze the data on Analyze vapor-liquid equilibrium and Boiling point diagram.
		CO2	Discuss the performance of the distillation column
		CO3	Explain the adsorption kinetics and isotherm at the Solid-Liquid interface.
		CO4	Understand the separation process by Liquid-Liquid Extraction and solid-liquid extraction.
		CO5	Discuss the crystallization process
Technical Presentation	**BCH 653**	CO1	Improve their communication skills.
		CO2	How to write refined reports of any technical topics
		CO3	To learn new challenging areas of their domain
		CO4	Knowledge of the application of Artificial Intelligence in Chemical Engineering.
		CO5	Knowledge of automation through ERP module training.
Sustainability of Environment	**BCH 062**	CO1	Understand the interaction between humans and the environment, including key ecological concepts, biodiversity, and pollution from chemical industries.
		CO2	Apply environmental laws, standards, and regulations for air, noise, and effluent management as set by control boards like CPCB and UPPCB.
		CO3	Implement resource conservation strategies using the 5R principles, alternative materials, and waste recovery methods for energy and water conservation
		CO4	Analyze air and water pollution sources, parameters, and control measures, including air pollution control equipment and wastewater treatment processes.
		CO5	Manage solid waste through effective practices for hazardous and non-hazardous waste, addressing plastic and e-waste challenges, and adhering to waste management laws.

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