Madhav Institute of Technology & Science, Gwalior

(A Govt. Aided UGC Autonomous & NAAC accredited Institute Affiliated to RGPV, Bhopal)

Chemical Engineering

Course Outcomes (COs) of theory & lab courses under Flexible Curriculum of 2017 admitted batch:

III Semester

After the completion of this course, Students will be able to

170302 (Organic Process Technology)	**CO1**	**Explain the processing of natural products**
	CO2	**Describe about microbial processes and edible oil refining process**
	CO3	**Elaborate the processes for producing petrochemicals**
	CO4	**Characterize polymers and elaborate its production processes.**
	CO5	**Describe the production processes of fibers**
	CO6	**Evaluate the different processes from economical aspects**

170303 (Fluid Mechanics)	**CO1**	**Explain the basic fundamentals of fluid statics & fluid flow.**
	CO2	**Estimate pressure drops, forces acting on bodies & power and head requirements of pumps.**
	CO3	**Apply equations of change to various fluid flow systems.**
	CO4	**Formulate the inter-dependency of various parameters using dimensional analysis.**
	CO5	**Determine the flow rate through different flow measuring devices.**
	CO6	**Examine the losses due to friction in pipes and other fluid machinery.**

3 (Fluid Mechanics	**CO1**	**Analyze the effects of flow measurement by flow measuring devices.**

	CO2	**Calculate the degree of error in discharge rate of rotameter.**
	CO3	**Calculate the coefficient of discharge for venturimeter and orifice meter.**
	CO4	**Calculate the coefficient of discharge for rectangular notch.**
	CO5	**Calculate the coefficient of discharge for triangular notch.**
	CO6	**Calibrate the flow measuring instruments.**

170304 (Material & Energy Balance)	**CO1**	**Explain different unit system, basic mass volume relationship, conversion of units**
	CO2	**Classify ideal and non –ideal gases**
	CO3	**Solve energy balance problems**
	CO4	**Analyze the recycle, bypass, and purge calculation**
	CO5	**Estimate the raw material requirement for synthesis of a chemical product based on stoichiometry**
	CO6	**Estimate the performance of chemical equipment using material and energy balance**

170304 (Material & Energy Balance Lab)	**CO1**	**Explain the boiling point variation with concentration of solute.**
	CO2	**Infer the relation of dry and wet bulb Thermometer with humidity**
	CO3	**Interpret the humidity charts to find the psychrometric properties and energy balance**
	CO4	**Apply the material balance of urea solution**
	CO5	**Apply the material balance in the Crystallization of copper sulphate solution**
	CO6	**Perform the material balance by Combustion analysis coal**

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170305 (Fluid Particle Mechanics	**CO1**	**Rephrase the application of Screen Analysis in Industry.**
	CO2	**Describe the various methods of size reduction and to list the various principles.**
	CO3	**Explain the separation techniques and equipments.**
	CO4	**Illustrate the various process like sedimentation, filtration etc.**
	CO5	**Compare the various conveying devices.**
	CO6	**Illustrate the fluidization and fluid catalytic process.**

170305 (Fluid Particle Mechanics Lab)	**CO1**	**Analyse the effectiveness of a given screen.**
	CO2	**Apply separation technique (sedimentation) to separate a mixture.**
	CO3	**Design size reduction ratio, grindability index using ball mill and jaw crusher.**
	CO4	**Compute Bond crushing laws using hammer mill.**
	CO5	**Design the plate and frame filter press, and thickener.**
	CO6	**Design, formulate, analyse and solve mathematical descriptions of mixing processes.**

170306 (Chemical Synthesis Lab)	**CO1**	**Research a specific compound, or a family of compounds, to propose a synthetic route for isolation of this compound.**
	CO2	**Perform advanced manipulations of apparatus relevant to a synthetic chemistry laboratory, use a Schlenk line to synthesize oxygen- and moisture-sensitive products.**
	CO3	**Characterize chemical compounds using modern spectroscopic techniques.**

	CO4	**Maintain a laboratory notebook following scientific best practices.**
	CO5	**Communicate findings in a format consistent with the scholarly standards of the chemical sciences.**
	CO6	**Articulate and follow ethical principles in a scientific context, including professional standards of laboratory practice, the communication of literature research without plagiarism,and the crediting of collaborators**

170307 (SWAYAM/NPTEL/ MOOC)	**CO1**	**Refer various technical resources available from multiple fields**
	CO2	**Adhere to deadlines and commitment to complete the assignment**
	CO3	**Improve his/her performance in the self learning domain**
	CO4	**Acquire additional knowledge helpful for competitive examinations**
	CO5	**Demonstrate understanding of various interdisciplinary & allied areas.**

IV Semester

After the completion of this course, Students will be able to

170402 (Heat Transfer)	**CO1**	**Apply the principles of different modes of heat transfer and heat transfer equipments.**
	CO2	**Analyze the heat transfer problems involving phase change.**
	CO3	**Illustrate the use of dimensionless numbers and various theoretical concepts.**
	CO4	**Interpret the physical systems involving heat transfer.**
	CO5	**Solve practical heat transfer problems.**
	CO6	**Estimate the design parameters of various heat transfer equipments.**

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170402 (Heat Transfer Lab)	**CO1**	**Analyze the various modes of heat transfer in chemical industries**
	CO2	**Analyze the application of various experimental heat transfer correlations in engineering applications**
	CO3	**Evaluate the thermal analysis and sizing of heat exchanger**
	CO4	**Evaluate the emissivity of materials**
	CO5	**Study the thermal conduction in metal rod**
	CO6	**Analyze the application of heat exchanging equipment in chemical process industries**

170403 (Mass Transfer - I)	**CO1**	**Explain the basics of absorption, humidification, drying, crystallization & the principle of diffusion underlying them.**
	CO2	**Infer the necessary information useful in design of mass transfer equipment.**
	CO3	**Analyze the different cases of diffusion phenomena.**
	CO4	**Apply the theoretical concepts for solving practical problems.**
	CO5	**Interpret psychometric charts & equilibrium data.**
	CO6	**Propose favorable conditions for a separation to be carried out.**

170403 (Mass Transfer - I Lab)	**CO1**	**Analyze the various applications of modern separation technique**
	CO2	**Design novel drying equipments for intended application.**
	CO3	**Evaluate the diffusion application in chemical industries**
	CO4	**Analyze the ability to know the application of humidification operation in chemical industry**
	CO5	**Evaluate the appropriate application equipment in a process**

	CO6	**Analyze the design of the mass transfer equipments used in crystallization processes**

170404 (Instrumentation & Process Control)	**CO1**	**Explain the basic principles & importance of process control in industrial process plants.**
	CO2	**Explain the use of block diagrams & the mathematical basis for the design of control systems.**
	CO3	**Identify controller that can be used for specific problems in chemical industry.**
	CO4	**Analyze the Dynamic behavior of first and second order control system.**
	CO5	**Compare the Linear open loop and Closed loop system.**
	CO6	**Analyze the stability of a given system & the transient and frequency response of systems.**

170407 (Process Control Lab)	**CO1**	**Tell the importance of process control in industrial process plants**
	CO2	**Explain the working of a flow control trainer and its applications**
	CO3	**Explain the working of a level control trainer and its applications**
	CO4	**Identify controller that can be used for specific problems in chemical industry**
	CO5	**Analyze the Dynamic behavior of first and second order control system**
	CO6	**Differentiate between interaction and non-interacting systems**

170405 (Mechanical Design of Process Equipment)	**CO1**	**Relate basics of Mechanical Design to industrial problems.**
	CO2	**Experiment with different heads, closures and other accessories involved doing design.**
	CO3	**Decide on general design considerations.**
	CO4	**Make use of IS Codes in design of Pressure vessel.**

	CO5	**Distinguish between design procedures for Tall Vertical & Horizontal Vessels.**
	CO6	**Outline the design of bolted flanges**

V Semester

After the completion of this course, Students will be able to

170501 (Chemical Engineering Thermodynamics)	**CO1**	**Infer the fundamental concepts of thermodynamics to chemical engineering applications.**
	CO2	**Explain the first and second laws of thermodynamics with their practical implications.**
	CO3	**Analyze the processes involving refrigeration and compression.**
	CO4	**Classify the thermodynamic properties of solutions with their relationships.**
	CO5	**Infer the detail of vapour liquid equilibria and its use in practical situations.**
	CO6	**Analyze the chemical equilibrium with thermodynamics for predicting behavior of reacting systems.**

170502 (Mass Transfer - II)	**CO1**	**Examine the basics of adsorption, leaching, distillation, liquid-liquid extraction & the principle of diffusion underlying them.**
	CO2	**Infer the necessary information useful in design of mass transfer equipment.**
	CO3	**Analyze the different contacting patterns & Analogies in transfer process.**
	CO4	**Apply the theoretical concepts for solving practical problems.**
	CO5	**Interpret the equilibrium data obtained in various mass transfer operations.**

	CO6	**Propose favourable conditions for a separation to be carried out.**

170503 (Mass Transfer - II Lab)	**CO1**	**Design calculation of distillation column**
	CO2	**Estimation of number of theoretical stages and composition of each plate**
	CO3	**Analyze the separation by adsorption and design of adsorber**
	CO4	**Design the spray and packed tower separation by liquid liquid extraction**
	CO5	**Analyze the separation by leaching**
	CO6	**Analyze the industrial application of separation equipments in process plant**

170503 (Chemical Reaction Engineering - I)	**CO1**	**Apply the basic concepts in the analysis of homogenous system and deviation from ideal behavior.**
	CO2	**Infer the necessary information useful in design of mass transfer equipment.**
	CO3	**Analyze the different contacting patterns & Analogies in transfer process.**
	CO4	**Apply the theoretical concepts for solving practical problems.**
	CO5	**Interpret the equilibrium data obtained in various mass transfer operations.**
	CO6	**Propose favourable conditions for a separation to be carried out.**

170503 (Chemical Reaction Engineering – I Lab)	**CO1**	**Analyze the chemical reactors and reaction systems.**
	CO2	**Examine the design of experiments involving chemical reactors.**
	CO3	**Analyze non ideality in real reactors.**
	CO4	**Examine the experimental analysis of batch reactor, plug flow reactor and CSTR.**
	CO5	**Examine the design and sizing of industrial scale reactor on the basis of kinetic data obtained at lab scale.**

	CO6	**Interpret the experimental data for useful purposes.**

170504 (Computational Methods in Chemical Engg.)	**CO1**	**Explain mathematical problems as applied to Chemical Engineering.**
	CO2	**Interpret the engineering data & the features of different numerical methods.**
	CO3	**Illustrate the use of numerical methods in Chemical Engineering scenario.**
	CO4	**Outline the scope of optimization in chemical processes & use of numerical solution of the ODEs.**
	CO5	**Simplify the solution of engineering problems using PDEs & ODEs.**
	CO6	**Solve PDEs & ODEs in various physico-chemical systems.**

170504(Computational Methods in Chemical Engg. Lab)	**CO1**	**Choose between various computational methods to solve a process problem.**
	CO2	**Present a contrast between analytical & numerical solutions.**
	CO3	**Construct functions & codes for different numerical methods.**
	CO4	**Solve ordinary & partial differential equations using the solvers in MATLAB.**
	CO5	**Analyze the solution of engineering problems using ordinary differential equations.**
	CO6	**Make use of numerical integration & interpolation while solving chemical engineering problems**

170505 (Inorganic Process Technology)	**CO1**	**Explain the basics of heavy and inorganic chemical industry**
	CO2	**Relate the importance of different unit operation and different unit processes involved in heavy and inorganic chemical industry**
	CO3	**Develop process flow diagram**

	CO4	**Analyze the major engineering problems involved in the process**
	CO5	**Evaluate different types of processes based on theconversion and yield of desireable products**
	CO6	**Importance of Fertilizer and cement technology**

170506 (Minor Project - I)	**CO1**	**Tell the basics of various unit operations & unit processes.**
	CO2	**Outline the necessary features to be utilized in undergoing any project work.**
	CO3	**Choose among experimental work, modeling & a combination of both for any problem statement.**
	CO4	**Choose among experimental work, modeling & a combination of both for any problem statement.**
	CO5	**Justify the background for selecting a suitable project title.**
	CO6	**Plan the work in phases for accomplishment of the project objective.**

170508 (SWAYAM/NPTEL/ MOOC)	**CO1**	**Refer various technical resources available from multiple fields**
	CO2	**Adhere to deadlines and commitment to complete the assignment**
	CO3	**Improve his/her performance in the self learning domain**
	CO4	**Acquire additional knowledge helpful for competitive examinations**
	CO5	**Demonstrate understanding of various interdisciplinary & allied areas.**

VI Semester

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170602(Process Modeling & Simulation)	**CO1**	**Explain the basic concepts involved in process analysis & simulation.**
	CO2	**Formulate a chemical engineering problem as a mathematical model from basic engineering principles.**
	CO3	**Apply the conservation equations in various physio – chemical systems.**
	CO4	**Examine the experimental data for further processing.**
	CO5	**Compare various iterative convergence methods and numerical solution of ODEs.**
	CO6	**Analyze different approaches involved in dynamic modelling of process systems.**

170602 (Process Modeling & Simulation Lab)	**CO1**	**Develop fundamental understanding of chemical engineering problems**
	CO2	**Develop dynamic model equations of chemical engineering systems**
	CO3	**Solve the differential equations by using different convergence methods**
	CO4	**Develop matlab code to solve dynamic model equations**
	CO5	**Analyze the plotted data generated by matlab code**
	CO6	**Analyze the variation of state variable with respect to time**

170611 (Process Equipment Design)	**CO1**	**Interpret the parameters in design problem statement.**
	CO2	**Apply the concepts of unit operations to design various process equipments.**
	CO3	**Find the property values at various process conditions.**
	CO4	**Justify the final design parameters in any process design.**

	CO5	**Distinguish between different methods employed in design calculations & designs available for specific equipment.**
	CO6	**Formulate certain rules of thumb to decide on some parameters encountered in process design.**

170612 (Fluidization Engg.)	**CO1**	**Explain the basics of fluidization**
	CO2	**Describe the various industrial application of fluidization**
	CO3	**Explain the various fluidization regimes, classification of particles**
	CO4	**Analyse Heat and Mass Transfer between fluid and solid**
	CO5	**Estimate Voidage, TDH, size distribution with height, viscosity, fluidity**
	CO6	**Evaluate Heat transfer coefficients in fluidized beds**

170613 (Multi – Component Distillation	**CO1**	**Select key component**
	CO2	**Solve number of theoretical and actual stages required for multi component distillation by usingvarious methods.**
	CO3	**Examine how to break azeotrope using azeotropic and extractive distillation.**
	CO4	**Estimate reflux ratio required for the distillation operation.**
	CO5	**Estimate tower diameter and operating pressure for multi distillation columns.**
	CO6	**Analyze various design options for energy conservation in distillation column.**

170614 (Polymer Technology)	**CO1**	**Analyze the classification of polymers, identification of their physical properties and establishing structure-property relations.**
	CO2	**Describe polymerization methods, emulsion and suspension techniques of polymerization.**

	CO3	**Apply governing equations for a polymerization process modeling.**
	CO4	**Analyze of polymer processing operations and choice of operation depending on the material and final product requirements.**
	CO5	**Estimate copolymerization and its kinematics along with its range and applicability.**
	CO6	**Examine various reactors for carrying out polymerization reactions.**

900109 (Fuels & Combustion)	**CO1**	**Explain the origin of fossil fuels**
	CO2	**Classify fossil fuels and their reserves in India**
	CO3	**Analyze various alternate energy options available in earth.**
	CO4	**Explain various fuel-processing techniques used in solid, liquid and gaseous fuels**
	CO5	**Examine characterization techniques for fuels**
	CO6	**Examine quality of fuels based on its properties and possible utilization**

900110 (Nanotechnology)	**CO1**	**Analyze the nanostructures and their properties.**
	CO2	**Examine the principles of processing, manufacturing of nanomaterials.**
	CO3	**Examine the nanomaterials and nanostructurescharacterization techniques.**
	CO4	**Examine the mechanical properties of bulk nanostructured metals, alloys, nanocomposites and carbon nanotubes**
	CO5	**Analyze the structure of materials down to the nanometer (atomic) level, with particular emphasis on crystal structure, nano-defects and their kinetics**

	CO6	**Analyze the application of nanomaterial and nanostructure.**

170607(Minor Project - II)	**CO1**	**Tell the basics of various unit operations & unit processes.**
	CO2	**Outline the necessary features to be utilized in undergoing any project work.**
	CO3	**Choose among experimental work, modeling & a combination of both for any problem statement.**
	CO4	**Choose among experimental work, modeling & a combination of both for any problem statement.**
	CO5	**Justify the background for selecting a suitable project title.**
	CO6	**Plan the work in phases for accomplishment of the project objective.**

Disaster Management (100007)	CO1	**Identify** disaster prevention and mitigation approaches.
	CO2	**Classify** global and national disasters, their trends and profiles.
	CO3	**Determine** the impacts of various disasters
	CO4	**Apply** Disaster Risk Reduction in management
	CO5	**Infer** the linkage between disasters, environment and development
	CO6	**Identify** Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders

VII Semester

After the completion of this course, Students will be able to

170711(Transport Phenomena)	**CO1**	**Explain the basic terminology of Transport phenomena.**
	CO2	**Apply shell balance to mass, momentum and heat transfer.**

	CO3	**Solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration**
	CO4	**Analyze industrial problems along with appropriate boundary conditions.**
	CO5	**Apply analogies among momentum, heat and mass transfer.**
	CO6	**Describe mechanisms of transport phenomena; present in given isothermal and non-isothermal, laminar and turbulent flow systems.**

170712(Equilibrium Staged Operations)	**CO1**	**Describe the fundamentals of separation operation.**
	CO2	**Describe the approximation technique and its algorithms for multi-component multistage separations.**
	CO3	**Interpret the equilibrium data obtained in the various separation operations.**
	CO4	**Analyze industrial problems along with equilibrium staged operations.**
	CO5	**Apply the knowledge of kinetics & transport**
	CO6	**Apply the mechanisms of industrial equilibrium separation operations.**

170713(Industrial Pollution Prevention & Control)	**CO1**	**Describe the industrial activities and fates of industrial contaminants.**
	CO2	**Describe the concept of pollution prevention, control and sustainability development**
	CO3	**Identify the laws and regulations pertained to pollution prevention and control**

	CO4	**Analyze the significance of different industrial pollution**
	CO5	**Identify the concepts of air pollution and methods**
	CO6	**Apply the principles of industrial water treatment methods**

170714(Petrochemical Technology)	**CO1**	**Identify the suitable feedstock and predict potential growth of petrochemical industries**
	CO2	**Describe the various aspects of production of olefin containing gases**
	CO3	**Identify the various aspects of important intermediate material for petrochemical industries**
	CO4	**Analyze the various aspects of cracking and polymerization processes.**
	CO5	**Identify the manufacturing methods of importance for petrochemical industries**
	CO6	**Identify the concepts of quality and environmental pollution control in petrochemical industries**

900211(Petroleum Processing Technology)	**CO1**	**Explain the chemistry of petroleum and its characterization.**
	CO2	**Analyze the petroleum refining and petrochemical processing and current scenario.**
	CO3	**Analyze the improvement for the profitability of refining and petrochemical complexes.**
	CO4	**Evaluate the application of advance technologies for petroleum exploration, production and economics of energy sector.**
	CO5	**Analyze the systems for ensuring safe, reliable design and operation of process unit.**
	CO6	**Design the parameters for safe, healthy environment in petrochemical industries.**

900223 (Industrial Safety & Hazards)	**CO1**	**Analyze the origin of hazards and fundamental principles of safety**
	CO2	**Analyze the issues related to toxicants and minimize the toxicants dose**
	CO3	**Explain the fire & explosion hazard and the controlling measurement techniques used in chemical industries**
	CO4	**Evaluate the professional obligations related to the plant management and maintenance to reduce energy hazard**
	CO5	**Analyze the risk analysis and plant reliability to reduce the hazard**
	CO6	**Formulate the HAZOP study, event tree analysis and fault tree analysis**

VIII Semester

After the completion of this course, Students will be able to

Internship/Project (170801)	**CO1**	**Identify** the problem after reviewing the Literature or field survey
	CO2	**Develop** non conventional prototypes for different chemical systems
	CO3	**Execute** experiments as per the target objectives
	CO4	**Compose** observations and results by using appropriate statistical tools or software
	CO5	**Develop** leadership and team work ability
	CO6	**Communicate** effectively by means of oral, written and graphical presentation

Professional Development (170802)	**CO1**	**Demonstrate** technical & non technical skills in in-house activities.
	CO2	**Demonstrate** good oral & written communication skills
	CO3	**Acquire** knowledge of new areas & emerging fields through MOOCs
	CO4	**Develop** leadership and team work ability

	CO5	**Take** positions of responsibility in professional organizations