SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Syllabus of Examination - AICTE Pattern

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-801 Chemical Process Modeling and Simulation

CMA-801	Chemical Process Modeling and Simulation	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

- To understand knowledge of fundamental principles and basic laws of modeling
- To understand the approach for mass/heat transfer & CRE
- To apply the knowledge of differential equations
- To understand the approach to modeling
- Formulation of a mathematical model for various chemical Engg. System.

Course Outcomes:

Students are able to model every Chemical Engineering system assigned to them. Moreover, they could make the program of the model equation to get output results and analyzed the performance of the system.

Unit-I: Introduction (07 Hours): Introduction, Uses of mathematical models, Scope of coverage, Principles of formulations, Introduction of Matlab and use of the language to solve modeling problems.

Unit-II: Mathematical Modeling in Chemical Reaction Engineering (15 Hours): Mathematical Modeling in Chemical Reaction Engineering: CSTR, PFR, Batch reactor, semibatch reactor, Series of isothermal CSTR, constant hold-up CSTR's, CSTR's with variable hold ups, gas phase pressurized CSTR, non isothermal CSTR, Bioreactor, trikle bed reactor. Simulation, program development and numerical solutions of above processes.

Unit-III Mathematical Modeling in Mass Transfer (15 Hours): Mathematical Modeling in Mass Transfer: Ideal binary distillation column, multicomponent non ideal distillation column, batch distillation with hold up, steam distillation, Multisolute batch liquid- liquid extraction, continuous extraction, multistage countercurrent extraction, plug flow type liquid- liquid extraction, reactor with mass transfer, Absorption, Adsorption. Simulation, program development and numerical solutions of above processes.

Unit-IV: Mathematical Modeling in Heat transfer (10 Hours): Mathematical Modeling in Heat transfer: Two heated tanks, single component vaporizer, double pipe heat exchanger, shell and tube heat exchanger, multicomponent flash drum, cooling towers. Simulation, program development and numerical solutions of above processes.

Unit-V: Mathematical Modeling in other chemical processes (12 Hours): Mathematical Modeling in other chemical processes: Interacting and non-interacting systems with and without heaters, isothermal hydraulic system, forward and backward feed triple effect evaporator, melting, batch reverse osmosis Unit, Real CSTR modeled with an exchange volume, Real CSTR modeled using by passing and dead space,

Two CSTR's with interchange. Simulation, program development and numerical solutions of above processes.

Text / References:

1. Process Optimization in Chemical Engineering by Edger Himmelblau.
2. Lubyen W. L., Process Modeling, Simulation and Control for Chemical Engineers, McGraw- Hill, New York, 1989.
3. Elements of Chemical Reaction Engineering by Fogler, Prentice Hall of India.
4. Mickley H. S., Sherwood T. S., Reed C. E., Application of Mathematical Modeling in Chemical Engineering, Tata-McGraw-Hill, New Delhi, 2002.
5. A. Kayode Coker, Modelling of Chemical Kinetics and Reactor Design, Gulf professional publication

CMA-801	**Chemical Process Modeling and Simulation**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiment:

1. Modeling and simulation of Chemical reaction processes
2. Modeling and simulation of mass transfer processes
3. Modeling and simulation of heat transfer processes
4. Modeling and simulation of fluidized process
5. Modeling and simulation of flash evaporator
6. Modeling and simulation of linear and non linear systems

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Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-802 (A) Chemical Process Equipment Design

CMA-802 (A)	**Chemical Process Equipment Design**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

- Provide students with a basic understanding equipment design.
- To teach students the design of pressure vessel.
- To teach students the design of the storage vessel.
- To teach students to apply the design concepts in practical industrial design problem.

Course Outcomes:

After completion of this course, the students will be able to do the design of industrial pressure vessel and storage vessel.

Unit-I: Importance of Chemical Process Equipment Design (10 Hours): Importance of chemical process equipment design, the design procedure for pressure vessels subjected to internal pressure, and combined loading, closures for pressure vessels, Code and standards for pressure vessels (IS:2825:1969), materials of construction, selection of corrosion allowance and weld joint efficiency.

Unit-II: Design of Pressure Vessels (08 Hours): Design of pressure vessels subjected to high pressure, monoblock construction, shrink fit construction, external pressure, optimum proportions of pressure vessels, optimum sizing of vessels.

Unit-III: Design of Supports (07 Hours): Design of supports, flanges, nozzles for vessels, Design of jackets, coils for pressure vessels.

Unit-IV: Mechanical Design of Storage Tanks (10 Hours): Mechanical design of storage tanks for volatile and non-volatile liquids, roof and bottom design, optimum proportions of the storage tank, storage tanks for solids and its design procedure, Design of cylindrical storage vessel.

Unit-V: Heat Exchangers Design (12Hours): Codes and standards for heat exchangers; Baffles; Tie-rods; Tube joining methods; Design of shell and tube heat exchangers, design of single effect evaporator, Design of distillation column, absorption column, and reactors.

Text / References:

1. Process equipment dsign-vessel design by Lloyd E. Brownell and Edwin Young, John Wiley, NewYork 1963.
2. Chemical Engineering Volume 6 – Design by J.M. Coulson, J.F. Richardson and R. K. Sinnott, Pergamon press International Edition 1989.
3. Introduction to chemical equipment design – Mechanical Aspects by B.C. Bhattacharyya, CBS Publications.
4. Process Equipment Design by M.V. Joshi and V.V. Mahajani Macmillan India
5. Pressure Vessel Hand book by Eugene F. Megyesy, Pressure vessel company, USA.
6. Design of machine elements by V.B. Bhandari, McGraw Hill.

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Syllabus of Examination - AICTE Pattern

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-802 (B) Novel Separation Technology

CMA-802 (B)	**Novel Separation Technology**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

- The objective of this subject is to expose students to understand advance separation technique for separation and its application to chemical engineering.
- To train students on advanced separation processes, thermodynamics of separation operations and equilibrium-based design methods.

Course Outcomes:

- To built advanced concepts of separation techniques used in chemical industries.
- To understand the principles and functioning advanced separation techniques.
- To understand the applications of advanced separation techniques as per industrial requirement..
- To recognize the selection criteria between advanced separation techniques and conventional separation techniques.

Unit-I: Separation Techniques (10 Hours): Limitations of common separation techniques – sedimentation, screening, filtration, evaporation, distillation, absorption, liquid-liquid and solid-liquid extraction. Principles of membrane separation process classification, characterization and preparation of membrane.

Unit-II: Analysis and Modeling of Membrane Separation (12 Hours): Analysis and modeling of membrane separation, Membrane modules and application. Reverse Osmosis and ultra-filtration, membrane characteristics and applications, Ion- selective membranes and their application in electrolysis.

Unit-III: Vaporization and Gas Separation (12 Hours): Vaporization and gas separation using membranes, Liquid membrane, Industrial applications. Liquid membrane separation, critical extraction, pressure swing adsorption and freeze drying, pervaporation and permeation, nano-separation. Foam and bubble separation, principle, classification, foam and surfactants, Separation techniques, Column Separations.

Unit-IV: Multi-Component Separation (10 Hours): Multi-component separation, Zone melting and Zone refining, electrophoresis, desalting by freezing, centrifugation.

Unit-V: Parametric Pumping (07 Hours): Parametric pumping, thermal parametric pumping, batch, continuous pumping, pH-parametric pumping, heatless parametric pumping.

Text / References:

1. Seader J. D. and Henley E. J., Separation Process Principles.
2. Suresh S, Keshav, A Textbook of Separation Processes.
3. King C. J, Separation Processes.
4. Arden T. V., Water Purification By Ion-exchange.

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Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-803 (A) Safety and Risk Analysis

CMA-803 (A)	**Safety and Risk Analysis**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

- To give knowledge of process plant safety, hazardous chemicals, fire and explosion hazards and different methods of hazard identification and its analysis in qualitative and quantitative scales.
- The students will introduce to personnel safety and case study problems.
- To develop the social, ethical and environmental responsibility among the students.
- To develop the safety concepts among the students with a detailed understanding of technical knowledge.
- To develop the responsibility and ability for precautions and remedial actions for any untoward event.

Course Outcomes:

At the end of the course, the student Students will gain knowledge of safety standards to be maintained at process industries and handling of problems related to safety, different methods of hazard identification and their analysis.

Unit-I: Introduction (12Hours): Introduction to process plant safety, handling of hazardous chemicals, Lower flammability limit (LFL), UFL, LEL, UEL, TLV, electrostatic hazards, Hazard code and explosive limit, TWA, Ceiling level, Safety in handling of gases, liquids and solids, Flammable liquid hazards, fire and explosion index, fireball hazards, oil spillage hazards, Bleveuvce, pool fires, jet fires, radiation hazards.

Unit-II: Fires and Explosions (18 Hours): The Fire Triangle, Distinction between Fires and Explosions, Definitions, Flammability Characteristics of Liquids and Vapors, Liquids, Gases and Vapors , Vapor Mixtures, Flammability Limit Dependence on Temperature and pressure, Estimating Flammability Limits, Limiting Oxygen Concentration and Inerting, Flammability Diagram, Ignition Energy, Autoignition, Auto-Oxidation, Adiabatic Compression, Ignition Sources, Method Energy of Chemical Explosions, Energy of Mechanical Explosions, Missile Damage Blast Damage to People, Vapor Cloud Explosions, Boiling-Liquid Expanding-Vapor Explosions.

Unit-III: Toxicology (12Hours): Toxic materials and their properties, effect of dose and exposure time, relationship and predictive models for response, Threshold value and its definitions, material safety data sheets, industrial hygiene evaluation.

Unit-IV: Risk Assessment (10 Hours): Review of Probability Theory, Interactions between Process Units, Revealed and Unrevealed Failures, Probability of Coincidence , Redundancy, Common Mode Failures, Event Trees, Fault Trees, Advantages and Disadvantages of Fault Trees, Relationship between Fault Trees and Event Trees.

Unit-V: Resources for Combating Fires (10 Hours): Resources for combating fires, dry chemical powders, firefighting foam, fixed and portable fire extinguishers, OSHA standards, the importance of plant layout in safety, the importance of site selection, personal safety, the role of human error in losses. Case studies of fires, explosions, disasters in chemical process plants.

Text / References:

1. Crawl D.A. and Louvar J.A, Chemical process safety fundamentals with applications.
2. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl and Joseph F. Louvar, Prentice Hall International Series, 2 nd Edition
3. Safe and Efficient Plant Operation and Maintenance, Greene R., McGraw Hill Book Co., New York.
4. Safety Management and Practices for Hazardous Units, Dekkar Marcel, McGraw Hill Book Co., New York, 1995
5. Safety and Good House Keeping, Saxena, National Productivity Council, New Delhi (1976), 3rd Edition.
6. Safety in Process Plant Design, Wells G.L., George Godwin Ltd., (1980).

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Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-803 (B) Petrochemical Technology

CMA-803 (B)	**Petrochemical Technology**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

To learn properties, application and production techniques of various Petrochemicals and to understand scientific and technological principles of organic synthesis and related unit processes.

Course Outcomes:

- An ability to apply acquired knowledge in the area of Petroleum Processing and Petrochemical Engineering
- Familiarize and understand various unit processes in synthesis of various Petrochemicals, with the present and emerging feed stock scenario and resource constraints
- Understand and remember various properties and applications of second and third generation petrochemicals.
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Unit-I: Introduction (10 Hours): Chemicals from methane and synthetic gas: Ammonia, Methanol and Hydrogen Cyanide.

Unit-II: Chemicals from Olefins (08 Hours): Ethylene derivatives, Propylene derivatives and Butylenes derivatives, Chemical from Aromatics**,** synthetic fibres, Plastics and rubber.

Unit-III: Conversion (08 Hours): Conversion of - Ethylene to ethylene oxide, ethylene glycol, ethanol amine Propylene to acrylic acid ,methyl ethyl ketone acrylonitrile**.**

Unit-IV: Conversion of Butane (08 Hours): Conversions of – Butanes to isobutene and n butanols, MIBK, MTBE Aromatics to maleic and phathalicanhydride, DMT, phenols and acetones Cyclohexane to caprolactum, adipic acid.

Unit-V: Hydration (10 Hours): Technologies for production of alcohols such as ethanol, isobutyl alcohol and higher alcohols, Esterification: Process for production of few esters such as acrylates, terephthalates, ester for flavoring industries.

Text / References:

1. Mall, I D, Petrochemical Process Technology.
2. Bhaskar Rao, Modern Petroleum Refining Processes.
3. Speight J, Chemistry & Technology of Petroleum.
4. Robert Mayer, Handbook of Petroleum Refining Processing.
5. N.N. Lebdev, Chemistry and technology of basic organic and petrochemical synthesis.
6. B.K. Bhaskarrao, A text on Petrochemicals, 2nd Ed, Khanna publishers, New Delhi.
7. G.N. Sarkar, Advanced Petrochemicals, 1st Ed, Khanna Publishers, New Delhi.

CMA-804 Project Stage-II

CMA-804	**Project Stage-II (Major)**	**0L:0T:16P**	**8 credits**	**32Hrs/Week**

Preambles:

The focus of the Industrial Training Project-II is on preparing a working system or some design or Understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any).