NIRMA UNIVERSITY
School of Engineering, Institute of Technology
B. Tech. in Chemical Engineering
Second Year / Semester III

Course Code	**2CH301**
Course Title	**Heat Transfer Operations**

Course Outcomes (CO):

At the end of the course, student will be able to –

1. explain the basic concepts and laws of different modes of heat transfer
2. apply principles of heat transfer with/ without phase change
3. analyse and demonstrate heat transfer to basic engineering systems
4. evaluate thermal performance of heat exchange equipments

Course Code	**2CH302**
Course Title	**Fluid Flow Operations**

Course Outcomes (CO):

At the end of the course, students will be able to –

1. study the concepts of fluid flow operations
2. apply fundamental flow equations to practical systems
3. estimate the performance of various fluid transport, metering and agitation devices
4. assess the behavior of fluids flowing in closed conduits

Course Code	**2CH303**
Course Title	**Solid Fluid Operations**

Course Outcomes (CO):

At the end of the course, students will be able to –

1. explain properties and ways to handle particulate solids
2. study various mechanical separation techniques and evaluate associated design variables
3. apply size reduction concepts to related equipment and assess their performance
4. demonstrate the application of fluidization

Course Code	2CH304
Course Title	Organic Chemistry

Course Outcomes (CO):

At the end of the course, students will be able to –

1. relate the fundamentals in developing the mechanism for different types of organic reaction,
2. outline the synthesis of various organic compounds,
3. identify the nature of organic compounds on the basis of investigations and also utilization of material safety data sheet,
4. comprehend the importance of organic compounds in industries and its impact on the global economy.

Second Year / Semester IV

Course Code	2CH401
Course Title	Mass Transfer Operations-I

Course Outcomes (CO):

At the end of the course, student will be able to –

1. outline the concepts of mass transfer operations
2. apply and demonstrate the fundamentals of mass transfer operations
3. elaborate the construction and working mechanism of mass transfer equipment
4. solve the problems pertaining to various mass transfer operations like diffusion, gas absorption, liquid-liquid extraction and leaching

Course Code	2CH402
Course Title	Chemical Process Industries

Course Outcomes (CO):

At the end of the course, students will be able to –

1. outline various chemical manufacturing processes
2. demonstrate the synthesis of chemical products and determine their properties
3. interpret the major engineering problems encountered during the manufacturing processes
4. compile recent developments and modern techniques in process industries

Course Code	2CH403
Course Title	Instrumentation and Process Control

Course Outcomes (CO):

At the end of the course, student will be able to -

1. classify and demonstrate open and closed loop control systems
2. select appropriate instruments for various applications in chemical industry
3. analyse the order of control system with its transfer function
4. design control loops with appropriate controllers and control valve

Course Code	2CH404
Course Title	Chemical Engineering Thermodynamics

Course Outcome:

At the end of the course, student will be able to -

1. develop and interpret mathematical expressions of various phase and reaction equilibrium phenomena
2. estimate heat and work interactions for different processes
3. apply the fundamentals of solution thermodynamics to calculate various phase equilibrium properties of pure components and mixtures
4. evaluate equilibrium conversion and product composition of chemical reactions

Course Code	2CH405
Course Title	Process Calculations

Course Outcomes (CO):

At the end of the course, students will be able to –

1. relate units, dimensions and basic chemical engineering principles
2. predict the performance of chemical processes by making use of the principles of material balance
3. appraise thermal property data for energy balance
4. discuss the principles of energy balance applied to chemical processes

Third Year / Semester V

Course Code	2CH501
Course Title	Mass Transfer Operations-II

Course Outcomes (CO):

At the end of the course, student will be able to-

1. outline concepts of various types of mass transfer operations
2. demonstrate and analyse mass transfer phenomenon in various systems
3. elaborate the construction and working mechanism of mass transfer equipment
4. solve problems pertaining to mass transfer operations like distillation, humidification, adsorption, drying and crystallization

Course Code	2CH502
Course Title	Environmental Pollution Control and Safety Management

Course Outcomes (CO):

At the end of the course, student will be able to-

1. infer the impact of engineering solutions in a global and societal context
2. explain issues related to fire and safety in chemical process industry
3. select appropriate measures to control and prevent different types of pollution
4. determine the parameters pertaining to different types of pollution

Course Code	2CH503
Course Title	Modeling and Simulation

Course Outcomes (CO):

At the end of the course, student will be able to-

1. explain the structure of modular and equation oriented mode simulators
2. identify the partitions of flow diagram and tear stream(s) for a given partition
3. develop mathematical models for different unit operations in chemical engineering
4. apply various simulators for simulation of the chemical processes

Course Code	2CHDE51
Course Title	Petroleum Refining Engineering

Course Outcomes (CO):

At the end of the course, student will be able to-

1. measure and predict the properties of crude oil and refinery product fractions
2. appreciate the modern techniques and recent developments for producing various refinery products
3. analyse fuels and other refinery products
4. apply hydrocarbon technology fundamentals in improving production methods

Course Code	2CHDE52
Course Title	Air Pollution Control Engineering

Course Outcomes (CO):

At the end of the course, student will be able to-

1. appraise fundamentals of sources, effects, sampling & monitoring of air pollutants
2. evaluate meteorological influence on air pollution
3. determine appropriate air pollution control systems for the industries
4. compare various methods to control specific air pollutant

Course Code	2CHDE53
Course Title	Dyes and Dye Intermediates Technology

Course Outcomes (CO):

At the end of the course, student will be able to-

1. identify various unit operations and unit processes involved in dyes and dye intermediates production
2. evaluate major engineering problems associated in production of dyes
3. analyze the various methods for synthesis of different intermediates used in dyes
4. demonstrate the colour changes with different classes of molecules

Course Code	2CHDE54
Course Title	Food Processing Technology

Course Outcomes (CO):

At the end of the course, student will be able to-

1. imbibe basic knowledge of food processing and food laws
2. identify various types of food adulteration
3. suggest appropriate food conversion operations
4. appreciate the modern techniques and recent developments for food processing, preservation and storage

Third Year / Semester VI

Course Code	2CH601
Course Title	Chemical Reaction Engineering-I

Course Outcomes (CO):

At the end of the course, student will be able to-

1. classify various reaction types and their mechanism
2. analyse and interpret experimental data from batch reactors to obtain rate expressions
3. select and design suitable reactor for single and multiple homogeneous reactions
4. determine optimal ideal reactor design for multiple reactions

Course Code	2CH602
Course Title	Process Equipment Design

Course Outcomes (CO):

At the end of the course, student will be able to-

1. interpret the basic fundamentals of process plant and equipment design
2. select and design equipment for gas – solid & liquid – liquid separation
3. design column for component separation from liquid mixture
4. apply fundamental knowledge and design equipment for heat transfer operations

Course Code	2CHDE55
Course Title	Nanotechnology in Chemical Sciences

Course Outcomes (CO):

At the end of the course, student will be able to-

1. comprehend the key concepts of material science, chemistry, physics, biology and engineering in the field of nanotechnology
2. distinguish various approaches for synthesis of nanomaterials
3. demonstrate a conceptual knowledge of instrumentation for the characterization of nanomaterials
4. identify the societal issues that may impede the adoption of nanotechnology

Course Code	2CHDE56
Course Title	Industrial Wastewater Treatment

Course Outcomes (CO):

At the end of the course, student will be able to-

1. outline conventional treatment units for industrial wastewater
2. develop wastewater treatment process for various sectors of process industries
3. compare diverse technologies for industrial wastewater treatment
4. determine appropriate advanced technologies for industrial wastewater

Course Code	2CHDE57
Course Title	Instrumental Methods in Chemical Sciences

Course Outcomes (CO):

At the end of the course, students will be able to-

1. relate the fundamentals of analytical chemistry in the field of engineering
2. identify the principles and applications of various analytical techniques
3. select and apply the appropriate method for analysis
4. evaluate the qualitative and quantitative results of the analysis

Course Code	2CHDE01
Course Title	Advanced Separation Techniques

Course Outcomes (CO):

At the end of the course, student will be able to-

1. appreciate various types of advanced separation techniques
2. elaborate the construction and working mechanism of advanced separation equipment
3. demonstrate the various methods of membrane preparations
4. explore alternative separation and reaction techniques to the existing ones

Course Code	2CHDE02
Course Title	Fertilizer Technology

Course Outcomes (CO):

At the end of the course, student will be able to-

1. demonstrate the use of fertilizers to improve soil productivity and crop yield
2. comprehend the manufacturing processes to produce various fertilizers
3. identify and solve major engineering problems in fertilizer manufacturing
4. develop skills to formulate bio fertilizers and mixed fertilizers as per requirement of farm land

Course Code	2CHDE03
Course Title	Polymer Technology

Course Outcomes (CO):

At the end of the course, student will be able to-

1. differentiate various polymers, their properties and applications
2. identify kinetics of various polymerization techniques
3. classify manufacturing and degradation aspects of polymers
4. select appropriate polymers for various applications

Course Code	2CHDE04
Course Title	Renewable Energy Sources

Course Outcomes (CO):

At the end of the course, student will be able to-

1. identify the present energy scenario and the need for energy conservation for future
2. appreciate various methodologies of tapping energy from non-conventional sources
3. explore non-renewable energy resources and effective technologies
4. devise application strategies by converting non-conventional energy sources into usable form

Course Code	2CHDE05
Course Title	Applied Chemical Process Thermodynamics

Course Outcomes (CO):

At the end of the course, student will be able to -

1. apply mathematical models for phase equilibrium and thermodynamic analysis calculations
2. estimate conversion for various chemical reactions by applying basic principles of chemical thermodynamics
3. evaluate various activity coefficient models and cubic equations of state for the VLE data
4. compare the use of thermodynamic models for any process simulator

Course Code	2CHDE06
Course Title	Solid Waste Management

Course Outcomes (CO):

At the end of the course, student will be able to-

1. outline the basic functions of solid waste management system
2. select and apply appropriate technique for the treatment of solid waste
3. make use of different techniques for hazardous waste, biomedical waste and e-waste management
4. compare various technologies for solid waste management

Course Code	2CHDE07
Course Title	Material Science

Course Outcomes (CO):

At the end of the course, student will be able to-

1. learn fundamental information of chemical engineering materials
2. apprehend the importance of qualitative and quantitative analogue of different materials
3. comprehend different material processing methods
4. select appropriate materials for various applications

Course Code	2CHOE01
Course Title	Chemical Analytical Techniques

Course Outcomes (CO):

At the end of the course, student will be able to-

1. relate the essential theory and principle of analytical techniques in various streams of engineering
2. identify the importance of specific analytical technique for any application
3. select and apply the appropriate analytical method to evaluate a sample
4. interpret the qualitative and quantitative results of analysis

Course Code	2CHOE02
Course Title	Air Pollution Control Techniques

Course Outcomes (CO):

At the end of the course, student will be able to-

1. appraise fundamentals of sources, effects, sampling & monitoring of air pollutants
2. evaluate air quality and specific source of air pollution
3. determine appropriate air pollution control systems for the industries
4. compare various methods to control specific air pollutant

Fourth Year / Semester VII

Course Code	2CH701
Course Title	Chemcal Reaction Engineering-II

Course Outcomes (CO):

At the end of the course, student will be able to-

1. comprehend the behaviour of various types of contacting patterns and kinetics involved in non-catalytic systems
2. identify non-ideality present and predict its effects on performance of reactor
3. develop rate expression, select and design suitable reactor for heterogeneous reactions
4. characterize various supported catalysts

Course Code	2CH702
Course Title	Plant Design, Economics and Project Management

Course Outcomes (CO):

At the end of the course, student will be able to-

1. summarize process design and development
2. develop structure and synthesis of process
3. analyze economics of the chemical industry projects
4. interpret the management of chemical industry projects

Course Code	2CHDE08
Course Title	Process Integration

Course Outcomes (CO):

At the end of the course, student will be able to-

1. outline process systems for continuous and batch processes
2. construct network for process utilities
3. compare network options and suggest appropriate option for the industry
4. evaluate alternatives for process integration in industries

Course Code	2CHDE09
Course Title	Process Plant Utilities and Energy Efficiency

Course Outcomes (CO):

At the end of the course, student will be able to-

1. select utilities and equipments for process requirement
2. identify energy saving opportunities in process utilities
3. analyze the utility system for energy conservation and efficiency
4. evaluate the performance of utility system

Course Code	2CHDE10
Course Title	Bioprocess and Bioseparation Engineering

Course Outcomes (CO):

At the end of the course, student will be able to-

1. apply knowledge of biological science and engineering to bio-catalysed reaction system
2. comprehend the mechanism and kinetics of enzyme/microbial catalysed reactions
3. identify suitable bioreactor for desired application
4. select suitable separation system for downstream processing

Course Code	2CHDE11
Course Title	Fundamentals of Piping Design

Course Outcomes (CO):

At the end of the course, student will be able to-

1. identify the piping fundamentals, codes and standards
2. select pipe fittings and make drawings and dimensioning
3. distinguish pipe material specifications
4. evaluate pressure drop of pipe systems

Course Code	2CHDE12
Course Title	Pharmaceutical Technology

Course Outcomes (CO):

At the end of the course, student will be able to-

1. relate chemical engineering operations with drugs and dosage form manufacturing
2. apply various chemical unit operations involved in drug manufacturing
3. evaluate different dosage forms
4. analyse good manufacturing practices

Course Code	2CHDE13
Course Title	Transport Phenomena

Course Outcomes (CO):

At the end of the course, student will be able to-

1. correlate analogy between different transport phenomena
2. predict transport properties for gases, liquids, solids, and mixtures
3. apply shell balance for energy, mass and momentum transport for various systems and develop mathematical expressions for transport of energy, mass and momentum
4. interpret transport property distribution for various systems

Course Code	2CHDE14
Course Title	Environmental Impact Assessment

Course Outcomes (CO):

At the end of the course, student will be able to-

1. illustrate concepts of sustainable development and EIA from perspective of chemical industries
2. relate legal aspects of EIA
3. plan overall process of EIA
4. interpret EIA reports of chemical industries

Course Code	2CHDE15
Course Title	Process Optimization

Course Outcome:

At the end of the course, student will be able to -

1. formulate the mathematical model for a given system
2. identify different mathematical models to fit the experimental data
3. select appropriate numerical method for the optimization of single variable and multivariable functions
4. apply linear programming and its application in optimization of chemical processes

Course Code	2CHDE16
Course Title	Advances in Chemical Process Control

Course Outcome:

At the end of the course, student will be able to-

1. analyse a feedback control system
2. explain advanced control systems
3. design control systems for multivariable processes
4. apply digital control system in chemical plant

Course Code	2CHDE17
Course Title	Unit Processes

Course Outcome:

At the end of the course, student will be able to-

1. adapt the concepts of kinetics and thermodynamics to various unit processes
2. acquire thorough knowledge of various manufacturing processes
3. solve associated major engineering problems
4. appreciate recent developments in unit process industries

Course Code	2CH703
Course Title	Minor Project

Course Outcomes (CO):

At the end of the course, student will be able to-

1. make use of acquired knowledge for the problem identification and definition
2. analyze the technical aspects of the project with a comprehensive and systematic approach
3. propose and select the appropriate solution
4. appraise the importance of an individual / team for effective execution
5. compile and conclude the project with effective communication amongst peers, mentors and society

Course Code	2CH704
Course Title	Summer Internship

Course Outcomes (CO):

At the end of the course, student will be able to-

1. perceive a better understanding of the engineering workplace
2. adapt competencies necessary for professional career
3. value interpersonal and human relationship skills
4. build the foundation for industrial internship / major project

Fourth Year / Semester VIII

Course Code	2CH801
Course Title	Major Project/Internship

Course Learning Outcomes (CO):

After successful completion of the course, student will be able to-

1. make use of acquired knowledge for the problem identification and definition related to industry / research / societal need
2. analyze the technical aspects of the project with a comprehensive and systematic approach
3. select the appropriate modern tool(s) and technique(s) for problem solving
4. propose and select the appropriate and cost effective solution
5. appraise the importance of an individual / team for effective execution
6. value the health, environment, safety and ethical practices during the project
7. perceive the possibility of scalability and scope of intellectual property rights
8. compile and conclude the project with effective communication amongst peers, mentors and society
9. develop life-long learning skills for productive career

Course Code	2CHOE26 (Open Elective-Mixed Pool)
Course Title	**Introduction to Fire and Safety Engineering**

Course Outcomes (CO):

At the end of the course, student will be able to-

1. explain the fire process and its chemistry
2. choose fire protection system
3. analyze fire accident
4. select fire insurance and policies

Course Code	2CHOE27 (Open Elective-Mixed Pool)
Course Title	**Green Chemistry and Technology**

Course Outcomes (CO):

At the end of the course, students will be able to-

1. comprehend the principles and concepts of green chemistry
2. identify the societal issues that may impede the adoption of green energy
3. recognize the importance of green chemistry and technology for safer environment
4. explain and apply the principles of green chemistry and technology