

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

L	T	P	C
2	1	2	4

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

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Second Year / Semester-III

L	T	P	C
2	1	2	4

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

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Second Year / Semester-III

L	T	P	C
3	0	2	4

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

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Second Year/Semester-III

L	T	P	C
3	0	2	4

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.

NIRMA UNIVERSITY
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Second Year / Semester IV

L	T	P	C
2	1	2	4

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

NIRMA UNIVERSITY
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Second Year / Semester-IV

L	T	P	C
3	0	2	4

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

NIRMA UNIVERSITY
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B. Tech. in Chemical Engineering
Second Year / Semester IV

L	T	P	C
3	0	2	4

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

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Second Year / Semester IV

L	T	P	C
3	1	0	4

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

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Second Year / Semester-IV

L	T	P	C
3	1	0	4

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

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Semester V

CH501 Mass Transfer Operations-II

[3 0 2 4]

Course Learning Outcome:

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

- understand the fundamentals of various types of mass transfer operations
- analyse a given industrial problem and apply concepts of mass transfer operations
- calculate number of theoretical stages and optimum operating conditions
- select a suitable equipment required for various types of mass transfer operations
- evaluate the performance of mass transfer operations

CH502 Chemical Engineering Thermodynamics-II

[3 0 0 3]

Course Learning Outcome:

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

- develop mathematical expressions of various phase and reaction equilibrium phenomena
- calculate phase equilibrium of binary/multi component systems using proper models
- identify the existence of azeotrope and calculate the azeotropic conditions
- apply the fundamentals of solution thermodynamics to calculate various phase equilibrium properties
- calculate equilibrium conversion and composition for reversible reactions

CH503 Instrumentation and Process Control

[3 0 2 4]

Course Learning Outcome:

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

- understand open and closed loop control systems
- analyse the order of control system with its transfer function
- evaluate the performance of control system with controllers and control valve
- design control loops with appropriate controllers and control valve
- apply appropriate instruments for various applications in chemical plant

CH504 Hydrocarbons Technology

[4 0 2 5]

Course Learning Outcome:

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

- understand the properties of crude oil and predict the refinery product fractions
- provide basic technological concepts associated with the production chain of various hydrocarbons
- appreciate the modern techniques and recent developments for producing various refinery products and petrochemicals
- apply hydrocarbon technology fundamentals in improving production methods
- provide basic technological concepts associated in production of various petrochemicals

CH505 Plant Utilities and Energy Efficiency

[3 0 0 3]

Course Learning Outcome:

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

- understand the fundamentals of plant utilities and energy efficiency
- select utilities and equipments for process requirement
- identify energy saving opportunities in process utilities
- analyze the utility system for energy conservation and efficiency
- evaluate the performance of utility system

CH506 Environmental Pollution Control and Safety Management [4 0 0 4]

Course Learning Outcome:

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

- understand and apply appropriate control and preventive measures for different types of pollution
- identify major process and occupational health hazards and apply hazard analysis techniques for risk assessment
- understand the impact of engineering solutions in a global and societal context
- acquire knowledge about the various environmental and safety standards and legislations

CH507 Mini Project – I

[0 0 2 1]

Course Learning Outcome:

After successful completion of the course, students will be able to

- practice acquired knowledge within the chosen area of technology for project development
- identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach
- reproduce, improve and refine technical aspects for engineering projects
- work as an individual or in a team in development of technical projects
- communicate and report effectively project related activities and findings

NIRMA UNIVERSITY
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Semester VI

CH601 Chemical Reaction Engineering-I

[3 0 2 4]

Course Learning Outcomes:

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

- understand homogeneous reactions and their reaction mechanism
- develop rate expression, select and design suitable reactor for single and multiple homogeneous reactions
- analyse the effect of change in reaction parameters on the rate of desired product formation
- understand the concept of residence time distribution for real reactors

CH602 Process Equipment Design

[4 0 4 6]

Course Learning Outcome:

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

- understand the basic design requirements of the process equipment
- appreciate function of process equipment or part of equipment
- design important process equipment
- understand the design considerations for cooling tower and pumps
- understand fundamentals of mechanical design of process equipment

CH6E1 Elective-I

[3 0 0 3]

CH611 Food Technology

[3 0 0 3]

Course Learning Outcome:

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

- imbibe the basic knowledge of food processing
- understand food laws and regulations governing the quality of foods
- appreciate the modern techniques and recent developments for food processing, preservation and storage
- identify various types of food adulteration and simple methods to detect adulteration of food
- identify the wide variety of parameters affecting food quality

CH621 Pharmaceutical Technology

[3 0 0 3]

Course Learning Outcome:

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

- understand the basics of pharmaceuticals
- relate chemical engineering operations with drugs and dosage form manufacturing
- apply various chemical processes in drug manufacturing
- identify and evaluate different dosage forms
- apply concept of good manufacturing practices

CH631 Nanoscience and Nanotechnology

[3 0 0 3]

Course Learning Outcome:

After successful completion of the course, students will be able to

- understand the key concepts in materials science, chemistry, physics, biology and engineering to the field of nanotechnology
- distinguish various approaches for synthesis of nanomaterials
- demonstrate a conceptual knowledge of instrumentation for the characterization of nanomaterials
- identify applications of nanotechnology and societal issues that may impede the adoption of nanotechnology

CH641 Dyes and Dye Intermediates Technology

[3 0 0 3]

Course Learning Outcome:

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

- understand various unit operations and unit processes involved in dyes and dye intermediates production
- understand various applicaitons and major engineering problems assoicated in production of dyes
- provide basic technological concepts associated with the production chain of various dyes and pigments
- analyse case studies of manufacturing of dyes and dye intermediates

CH651 Fertilizer Technology

[3 0 0 3]

Course Learning Outcome:

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

- understand various manufacturing process involved in production of fertilizers
- acquire basic knowledge of various nutrients required at different stage of plant growth and their deficiency symptoms.
- understand the major engineering problems encountered during the manufacturing processes
- acquire knowledge of bio fertilizers, slow release fertilizers and their applications.

CH661 Polymer Technology

[3 0 0 3]

Course Learning Outcome:

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

- classify polymers on different basis
- identify kinetics of various polymerization techniques
- understand manufacturing and degradation aspects of polymers
- differentiate various polymers, their properties and applications
- select appropriate polymers for various applications

CH6E2 Elective-II

[3 0 0 3]

CH612 Advanced Separation Techniques

[3 0 0 3]

Course Learning Outcome:

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

- understand the fundamentals of various types of advanced separation techniques
- analyse a given industrial separation/problem and apply concepts of advanced separation techniques
- explore use of alternative separation techniques to the existing ones
- analyse and compare membrane reactors with conventional reactors

CH622 Advances in Chemical Process Control

[3 0 0 3]

Course Learning Outcome:

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

- analyse and evaluate a feedback control system
- understand and analyse advanced control systems
- design control systems for multivariable processes
- apply digital control system in chemical plant

CH632 Process Integration

[3 0 0 3]

Course Learning Outcomes:

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

- calculate minimum hot and cold utilities and develop heat exchanger networks
- apply the principles of appropriate placement of reactors and distillation columns with respect to heat integration
- evaluate various alternatives for heat integration of distillation columns for energy savings
- apply principles of mass exchanger networking to develop mass exchanger network
- calculate the batch cycle time required for a single/multi product plant
- use different software for heat exchanger network and water networking

CH642 Advanced Chemical Instrumentation Techniques

[3 0 0 3]

Course Learning Outcome:

After successful completion of the course, students will be able to

- understand the concepts, principles and theories relating to the instrumentation techniques
- recognize the advantages and limitations of the modern instrumentation techniques
- select appropriate instrumental methods

CH652 Air Pollution Control Engineering

[3 0 0 3]

Course Learning Outcome:

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

- understand the fundamentals of air pollution, the major collection mechanism and equipments/instruments for a given gaseous or particulate pollutants
- select and apply the most appropriate air pollution control system
- understand the fundamentals of indoor and odour pollution
- understand different methods for controlling emissions from stationary and mobile sources
- apply the concept of air pollution control engineering to the professional society and general public

CH603 Computational Chemical Engineering Laboratory

[0 0 2 1]

Course Learning Outcome:

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

- manipulate various chemical engineering models for solution using numerical methods
- select appropriate inbuilt functions of computational tools for solving chemical engineering problems
- apply various computational tools for solving problems in chemical engineering field

CH604 Mini Project – II

[0 0 2 1]

Course Learning Outcome:

After successful completion of the course, students will be able to

- practice acquired knowledge within the chosen area of technology for project development
- identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach
- reproduce, improve and refine technical aspects for engineering projects
- work as an individual or in a team in development of technical projects
- communicate and report effectively project related activities and findings

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Semester VII

CH701 Chemical Reaction Engineering - II

[3 0 2 4]

Course Learning Outcome:

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

- identify non-ideality present and predict its effects on performance of reactor
- understand the behaviour of various types of contacting patterns and phases involved in the reaction
- develop rate expression, select and design suitable reactor for heterogeneous reaction
- prepare and characterize various supported catalysts

Course Learning Outcome:

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

- develop mathematical models that satisfy the practical constraints for a particular unit operation
- understand the structure of modular mode and equation oriented mode simulators
- identify the partitions of flow diagram and tear stream(s) for a given partition
- identify and specify the required degrees of freedom for any given unit operation
- apply various simulators for simulation of the chemical process

CH703 Transport Phenomena

[3 0 0 3]

Course Learning Outcome:

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

- understand the fundamentals of transport phenomena and analogy between different transport phenomena
- predict transport properties for gases, liquids, solids, and mixtures
- apply shell balance for energy, mass and momentum transport for various systems and develop mathematical expressions for transport of energy, mass and momentum
- interpret transport property distribution for various systems

CH7E3 Elective-III

[3 0 0 3]

CH713 Non-Conventional Energy Sources

[3 0 0 3]

Course Learning Outcome:

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

- understand the basic principles and fundamentals of energies behind the non-conventional sources
- compare the various methodologies of tapping energy from non-conventional sources
- devise application strategies by converting non-conventional energy sources into usable form

CH723 Bioprocess Engineering

[3 0 0 3]

Course Learning Outcome:

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

- apply knowledge of biological science and engineering to bio-catalyzed reaction systems
- understand mechanism and kinetics of enzyme/microbial catalyzed reactions
- select suitable bioreactor for desired application
- select suitable separation system for downstream processing

CH733 Wastewater Engineering

[3 0 0 3]

Course Learning Outcome:

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

- understand the importance of unit operations in the handling and treatment of wastewater
- select and design suitable wastewater treatment process
- critically analyse problems that may arise in the operation of wastewater treatment plant
- appreciate the concepts of advanced treatment, recycle and reuse of wastewater

CH743 Advanced Chemical Engineering Thermodynamics

[3 0 0 3]

Course Learning Outcome:

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

- apply network of thermodynamic equations to calculate various properties
- calculate phase equilibrium using various activity coefficient models and cubic equations of state
- select appropriate models for calculation of phase equilibrium
- calculate equilibrium conversion for various chemical reactions
- select proper thermodynamic models for process simulator

CH7E4 Elective-IV [3 0 0 3]

CH714 Catalytic Reaction Engineering

[3 0 0 3]

Course Learning Outcome:

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

- select suitable catalyst, synthesis methods and its characterization techniques
- develop rate expressions for given reaction conditions for heterogeneous catalytic processes
- suggest suitable contacting patterns and reactor configurations
- suggest suitable reactor for given reaction conditions

CH724 Chemical Engineering Economics and Plant Design

[3 0 0 3]

Course Learning Outcome:

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

- understand the project evolution and evaluation techniques
- manage the project, plant and process requirements
- carry out detail discussion in industry in all aspects of plant design and its requirement
- carry out economic and profitability analysis, alternative investments, planning and scheduling at various level

CH734 Process Optimization

[3 0 0 3]

Course Learning Outcome:

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

- understand the scope and areas of application of optimization
- formulate the mathematical model for a given optimization problem
- fit functions to the empirical data and understand the concept of convexity in optimization
- apply various numerical methods for the optimization of single variable and multivariable problems
- optimize linear programming problems

CH744 Unit Processes

[3 0 0 3]

Course Learning Outcome:

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

- understand the concepts of kinetics and thermodynamics of unit processes
- acquire knowledge of various organic reactions and their mechanisms
- understand the applications and major engineering problems associated with unit processes
- appreciate the advancements in unit processes

CH704 Minor Project

[0 0 4 2]

Course Learning Outcome:

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

- practice acquired knowledge within the chosen area of technology for project development
- identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach
- reproduce, improve and refine technical aspects for engineering projects
- work as an individual or in a team in development of technical projects
- report project related activities effectively to peers and mentors

SP701 Practical Training

[0 0 0 0]

Course Learning Outcome:

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

- explore the preferred field of specialization and develop analytical/hardware/software/ experimental/observation skills
- manage the technical content and work
- prepare and present technical report

Semester VIII

CH801 Major Project

[0 0 0 26]

Course Learning Outcome:

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

- use various tools and techniques to study existing systems
- critically analyse existing systems, thereby select and justify parameters to be improved
- start and manipulate proposed engineering solution as per industry / research / societal need
- achieve precision in uses of the tools related to their experiments/fabrication
- reorganize and refine various components of technology to optimize the resources at large
- appraise the potential of technology for scalability and wide spectrum of applications
- report project related activities effectively to peers, mentors and society
- follow and value health, safety and ethical practices during project