**NIRMA UNIVERSITY**
**School of Engineering, Institute of Technology**
**B.Tech. in Chemical Engineering**
**Third Year/Semester V**

| | |
|---|---|
| **Institute:** | Institute of Technology |
| **Name of Programme:** | B. Tech. (Chemical Engineering) |
| **Course Code:** | 3CH601ME24 |
| **Course Title:** | Unit Processes |
| **Course Type:** | Department Elective |
| **Year of introduction:** | 2024-25 |

| L | T | Practical component | | | |
|---|---|---|---|---|---|
| | | LPW | PW | W | S |
| 3 | 1 | - | - | - | - |

**Course Learning Outcomes (CLOs):**

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

1. relate the concepts of kinetics and thermodynamics to various unit processes (BL2)
2. perceive knowledge of various manufacturing processes (BL5)
3. identify and solve major engineering problems in various unit processes (BL3)
4. list recent developments in unit process industries (BL4)

| | Contents | Teaching hours (Total 45) |
|---|---|---|
| **Unit I** | **Thermodynamics and Kinetics in Unit Processes**<br>Introduction to reaction mechanisms, factors affecting chemical process, applications of thermodynamics and chemical kinetics in various unit processes. | **05** |
| **Unit II** | **Nitration and Sulphonation**<br>Aromatic nitration, industrial nitration processes and various products, production of nitro paraffin's, major engineering problems, sulfonating and sulphating agents and their applications, chemical and physical factors, sulfonation of aromatic compounds, preparation of sulfonates and sulphates. | **12** |
| **Unit III** | **Halogenation and Esterification**<br>Chlorination of methane and ethane, photohalogenaiton, esterification by organic acids, esterification of carboxylic acid derivatives, major engineering problems involved. | **10** |
| **Unit IV** | **Amination by Reduction and Ammonolysis**<br>Amminating agents, amination reactions, electrolytic reductions, metal and alkali reductions, physical and chemical factors affecting ammonolysis, manufacture of various amino compounds. | **08** |
| **Unit V** | **Oxidation, Hydrolysis and Alkylation**<br>Types of oxidative reactions, vapor-phase oxidation of aromatic hydrocarbons, hydrolysing agents, operations involving hydrolysis, | **10** |

hydrolysis of alkyl chlorides and esters, types of alkylation, factors controlling alkylation, latest developments in various unit processes.

**Self Study:**

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

**Tutorial Work:**

Tutorial work will be based on the above content of course.

**Suggested Readings/References:**


1. Groggins P. H., Unit Processes in Organic Synthesis, Tata McGraw-Hill Edition.
2. Jerry March., Advanced Organic Chemistry: Reactions, Mechanisms and Structures, John Wiley Sons.
3. Arun Bahl and Bahl B. S., Advanced Organic Chemistry, S. Chand & Company Ltd.


L= Lecture, T=Tutorial, P= Practical, C=Credit

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**B.Tech. in Chemical Engineering**
**Third Year/Semester V**

| | |
|---|---|
| **Institute:** | Institute of Technology |
| **Name of Programme:** | B. Tech. (Chemical Engineering) |
| **Course Code:** | 3CH401ME24 |
| **Course Title:** | Pharmaceutical Technology |
| **Course Type:** | Department Elective |
| **Year of introduction:** | 2024-25 |

| **L** | **T** | **Practical component** | | | |
|---|---|---|---|---|---|
| | | **LPW** | **PW** | **W** | **S** |
| 3 | 1 | - | - | - | - |

**Course Learning Outcomes (CLOs):**

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

1. relate the basics of pharmaceutics (BL2)
2. evaluate different dosage forms (BL5)
3. distinguish drug delivery systems (BL4)
4. analyse good manufacturing practices in pharmaceutical industries (BL4)

| | **Contents** | **Teaching hours (Total 45)** |
|---|---|---|
| **Unit I** | **Overview of Pharmaceutical Industry – Unit Operations**<br>Introduction to pharmaceutical science, basics of drugs, their applications and dosage forms, Indian & global scenario of pharma sector. Introduction to pharmacopoeia. Role of Chemical Engineer in pharma industries.<br>Unit operations involved in manufacturing of pharmaceutical products. | **08** |
| **Unit II** | **Conventional Dosage Forms and Preparation**<br>Pharmaceutical solutions, Pharmaceutical disperse systems: suspensions, emulsions and creams, ointments, pastes, lotions, gels, parenteral formulations, ocular, nasal and optic dosage forms, vaginal and rectal dosage forms, respiratory dosage forms<br>Solid-dosage forms: tablets, capsules | **12** |
| **Unit III** | **Drug Delivery Systems**<br>Conventional drug delivery, advanced systems in drug delivery: controlled release, delayed release, modified, novel drug delivery systems | **12** |
| **Unit IV** | **Packaging of Dosage Forms**<br>Various packaging for different dosage forms, material selection, methods and equipment used for packaging, packaging and regulatory bodies, repackaging, and designing packaging for safe medicine use. | **08** |
| **Unit V** | **Good Manufacturing Practices (GMP)**<br>Introduction to good manufacturing practices (GMP) in the pharmaceutical Industry, Importance, guidelines and components of | **05** |

GMP.

**Self Study:**

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

**Tutorial Work:**

Tutorial work will be based on the above content of course.

**Suggested Readings/References:**


1. Lachman, Leon, Herbert A. Lieberman, and Joseph L. Kanig. The theory and practice of industrial pharmacy. Philadelphia: Lea & Febiger,
2. Remington, Joseph Price. Remington: The science and practice of pharmacy. Vol. 1. Lippincott Williams & Wilkins.
3. Jones, David S. FASTtrack Pharmaceutics dosage form and design. Pharmaceutical press.
4. Perrie, Yvonne, and Thomas Rades. FASTtrack Pharmaceutics: Drug Delivery and Targeting. Pharmaceutical press.
5. Aulton, Michael E., and Kevin Taylor, eds. Aulton's pharmaceutics: the design and manufacture of medicines. Elsevier Health Sciences.


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**Third Year/Semester V**

| | |
|---|---|
| **Institute:** | Institute of Technology |
| **Name of Programme:** | B. Tech. (Chemical Engineering) |
| **Course Code:** | 3CH402ME24 |
| **Course Title:** | Fertiliser Technology |
| **Course Type:** | Department Elective |
| **Year of introduction:** | 2024-25 |

| **L** | **T** | **Practical component** | | | |
|---|---|---|---|---|---|
| | | **LPW** | **PW** | **W** | **S** |
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**Course Learning Outcomes (CLOs):**

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

1. demonstrate the use of fertilisers to improve soil productivity and crop yield (BL2)
2. perceive knowledge about manufacturing process to produce various fertilisers (BL5)
3. analyse and solve major engineering problems in fertiliser manufacturing (BL4)
4. develop skills to formulate bio fertilisers and mixed fertilisers as per requirement of farm land (BL3)

**Contents**

**Unit I** **Over View of Fertilisers**

Need of fertilisers, types of fertilisers, merits and demerits of fertilisers, applications of fertilisers, fertiliser industry in India and its comparison with world's fertiliser industry, various nutrients required at different stages of plants and their deficiency symptom, soil fertility testing methods, impact of fertilisers on environment.

**Unit II** **Nitrogenous Fertilisers**

Production of ammonia, urea, nitric acid, ammonia nitrate, ammonia sulphate – major engineering problems, storage and handling.

**Unit III** **Phosphatic and Potassic Fertilisers**

Mining of phosphate rock, phosphate rock processing, production of normal superphosphate, triple superphosphate, ammonium phosphate, nitro phosphate, potassium chloride, potassium sulphate, potassium nitrate, potassium hydroxide.

**Unit IV** **Mixed Fertilisers**

Manufacture & granulation of mixed fertilisers, various grades of NPK fertilisers, application of various types of fertilisers with respect to crops and type of soil.

**Unit V** **Bio-fertilisers and Slow-release Fertilisers**

Introduction to bio-fertilisers, types of bio-fertilisers, methods of applications of bio-fertilisers, advantages of bio-fertilisers over other fertilisers, slow-release fertilisers, nano fertilisers, organic farming.

**Self Study:**

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

**Tutorial Work:**

Tutorial work will be based on the above content of course.

**Suggested Readings/References:**


1. Austin G. T, Shreve's., Chemical Process Industries, McGraw Hill Publications.
2. Slack A.V., Chemistry and Technology of Fertilisers, Wiley Interscience Publications
3. Gopala Rao. M, Marshall. S., Dryden's Outlines of Chemicals Technology, East West Publications.
4. Subba Rao N.S., Biofertilisers in Agriculture, Oxford and IBH Publishing Company.


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**Third Year/Semester V**

| | |
|---|---|
| **Institute:** | Institute of Technology |
| **Name of Programme:** | B. Tech. (Chemical Engineering) |

| | |
|---|---|
| **Course Code:** | 3CH701ME24 |
| **Course Title:** | Air Pollution Control Engineering |
| **Course Type:** | Department Elective |
| **Year of introduction:** | 2024-25 |

| **L** | **T** | **Practical component** | | | |
|---|---|---|---|---|---|
| | | **LPW** | **PW** | **W** | **S** |
| 3 | - | 2 | - | - | - |

**Course Learning Outcomes (CLOs):**

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

1. interpret fundamentals of sources and effects of air pollutants (BL2)
2. illustrate sampling and monitoring procedures for air monitoring (BL2)
3. choose appropriate air pollution control systems for the industries (BL3)
4. develop proper strategy to control specific pollutant (BL3)

| | **Contents** | **Teaching Hours (Total 45)** |
|---|---|---|
| **Unit I** | **Meteorological and Legal Aspects of Air Pollution**<br>Air pollution in India and the World, sources and classification of air pollutants, global concern of air pollutants, effects of air pollutants, temperature lapse rates and stability, meteorological factors influencing air pollution, plume behaviour, dispersion of air pollutants and estimation of plume rise, National laws and International treaties related to Air pollution | **12** |
| **Unit II** | **Air Quality Sampling and Monitoring**<br>Types of pollutant sampling and measurement, ambient air sampling, stack sampling, analysis of air pollutants | **08** |
| **Unit III** | **Air Pollution Control Techniques**<br>Source correction methods, particulate control techniques like gravity settling chambers, cyclone separator, filters, electrostatic precipitator, wet scrubbers, control technologies for gaseous pollutants like Scrubbers, absorption and adsorption, Industrial case studies, Air pollution from stationary and mobile sources. | **14** |
| **Unit IV** | **Control of Specific Pollutants**<br>Control of specific gaseous pollutants like $SO_x$, $NO_x$. recent trends in air pollution control techniques, Control of volatile organic compounds (VOCs) and odour: Environmental significance of organic compounds and its control, Sources and characteristics of odour, measurement and control of odour. Indoor air pollutants and its effects, factor influencing indoor air quality, control of indoor air pollutants. | **11** |

**Self Study:**

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

**Laboratory Work:**

Laboratory work will be based on the above content of course.

**Suggested Readings/References:**


1. Bouble R. W., Fox D. L., Turner D. B., Stern A. C., Fundamentals of Air Pollution, Academic Press.
2. Rao C. S., Environmental Pollution Control Engineering, New Age International Publication
3. Rao M. N., Rao H. V. N., Air Pollution, Tata McGraw Hill Publication.
4. Mudakavi J. R., Principles and Practices of Air Pollution Control and Analysis, I. K. International Publication
5. Bhatia S. C., Textbook of Air Pollution and its Control, Atlantic Publishers & Distributors.
6. Trivedy R. K., Goel P. K., An Introduction to Air Pollution, BS Publications.


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**List of Experiments:**

| Sr. No. | Practical | No. of Hours |
|---|---|---|
| 1 | To determine the respirable particulate matter in ambient air. | 02 |
| 2 | To measure the SOx concentration present in ambient air. | 02 |
| 3 | To measure the NOx concentration present in ambient air. | 02 |
| 4 | To measure the $PM_{2.5}$ & $PM_{10}$ concentration present in ambient air. | 02 |
| 5 | Develop of wind rose diagrams using local data. | 02 |
| 6 | To measure velocity, temperature and determination of PM from the stationary sources. | 02 |
| 7 | Measurement of SOx releasing from the stationary sources. | 02 |
| 8 | Measurement of NOx in stack from the stationary sources. | 02 |
| 9 | To estimate the maximum ground level concentration of different pollutants releasing from the stationary sources. | 02 |
| 10 | To estimate efficiency of the cyclone separator. | 02 |