# Veermata Jijabai Technological Institute (V.J.T.I)

(Central Technological Institute, Maharashtra State, INDIA)
H. R. Mahajani Marg, Matunga, Mumbai 400019

Tel.No. +91 22 24198101-02 Fax: +91 22 24102874 Website: www.vjti.ac.in

**Programme Name: Diploma In Chemical Engineering**

| | | | |
|---|---|---|---|
| **Programme Code** | **: DCHE** | **With Effect From Academic Year** | **: 2023-24** |
| **Duration of Programme** | **: 6 Semester** | **Duration** | **: 16 WEEKS** |
| **Semester** | **: Fifth** | **Scheme** | **: R-2023** |

| Sr No | Course Title | Abbreviation | Course Type | Course Code | Total IKS Hrs for Sem. | Learning Scheme | | | | | Credits | Assessment Scheme | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Actual Contact Hrs./Week | | | Self-Learning (Micro Projects/ Assignments/ Activities) | Notional Learning Hours /Week | | Paper Duration (hrs.) | Theory | | | | Based on LL & TL | | | | Based on Self Learning | | Total Marks |
| | | | | | | | | | | | | | | | | | Practical | | | | | | |
| | | | | | | CL | TL | LL | | | | | FA-TH(MST) | SA-TH(ESE) | Total | | FA-PR(CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | | | | | | | | Max | Max | Max | Min | Max | Min | Max | Min | Max | Min | |
| 1 | INDUSTRIAL TRAINING (8 weeks in summer break after 4 Sem) | ITR | SEC | 235CH51 | | - | - | - | - | 0 | 4 | - | - | - | - | - | 100 | 40 | 100# | 40 | - | - | 200 |
| 2 | CHEMICAL REACTION KINETICS | CRK | DSC | 235CH52 | | 3 | 1 | 3 | - | 7 | 3.5 | 3 | 30 | 70 | 100 | 40 | 25 | 10 | 50# | 20 | - | - | 175 |
| 3 | HEAT TRANSFER AND APPLICATIONS | HTA | DSC | 235CH53 | | 3 | 1 | 3 | - | 7 | 3.5 | 3 | 30 | 70 | 100 | 40 | 25 | 10 | 50# | 20 | - | - | 175 |
| 4 | CHEMICAL ENGINEERING DRAWING AND DESIGN | CEDD | DSC | 235CH54 | | 2 | - | 3 | - | 5 | 2.5 | 3 | 30 | 70 | 100 | 40 | 25 | 10 | 25# | 10 | - | - | 150 |
| 5 | INDUSTRIAL MANAGEMENT | IM | AEC | 235CH55 | | 3 | - | - | 1 | 4 | 2 | 3 | 30 | 70 | 100 | 40 | 25 | 10 | - | - | 25 | 10 | 150 |
| 6 | ELECTIVE (ANY ONE) | ELE | GE | 235CH56 | | 3 | - | - | - | 3 | 1.5 | 3 | 30 | 70 | 100 | 40 | - | - | - | - | - | - | 100 |
| 7 | PROJECT-I | PRJ | INP | 235CH57 | | | - | 6 | - | 6 | 3 | | - | - | - | - | 50 | 20 | 50# | 20 | - | - | 100 |
| **Total** | | | | | - | **14** | **2** | **15** | **1** | **32** | **20** | | **150** | **350** | **500** | | **250** | | **275** | | **25** | | **1050** |

**Abbreviations:** CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

**Legends:** @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination

**Course Category:** Discipline Specific Course Core (DSC): 2, Discipline Specific Elective (DSE) : 0, Value Education Course (VEC) : 1, Intern./Apprenti./Project./Community (INP) : 0, Ability Enhancement Course (AEC) : 2, Skill Enhancement Course (SEC) : 2, Generic Elective (GE) : 0

Curriculum Coordinator

Head of the Diploma Chemical Engineering (DCHE)

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE DIP. EXAM MATUNGA MUMBAI-19

Dean Diploma

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**Programme: Diploma in CHEMICAL ENGINEERING (DCHE)** **Semester: V** **Implemented from: 2023**

LIST OF ELECTIVE SUBJECTS

| Sr. No. | SUBJECT |
|---|---|
| 1 | Numerical Methods in Chemical Engineering |
| 2 | Agrochemical Technology |
| 3 | Pharmaceutical Technology |
| 4 | Biochemical Technology |
| 5 | Material and Energy Balances |
| 6 | Thermal System Design |

Curriculum Coordinator

Head of the Diploma Chemical Engineering (DCHE)

Dean Diploma

BOS VJTI Approval dated 10/07/2024

| | |
|---|---|
| **DIPLOMA PROGRAMME** | **: DIPLOMA IN CHEMICAL ENGINEERING** |
| **PROGRAMME CODE** | **: DCHE** |
| **SEMESTER** | **: FIFTH** |
| **COURSE TITLE** | **: INDUSTRIAL TRAINING** |
| **COURSE CODE** | **: 235CH51** |

## I. TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| - | - | - | - | 4 | - | - | - | - | - | - | 100 | 40 | 100# | 40 | - | - | 200 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

Globalization has prompted organizations to encourage skilled and innovative workforce. Internships are educational and career development opportunities, providing practical/ hands-on experience in a field or discipline. Summer internship is an opportunity for students to get accustomed to modern industry practices, apply the knowledge and skills they've acquired in the classroom to real-world situations and become familiar with industry environments before they enter the professional world. Keeping this in mind, industrial training is incorporated to all diploma programmes as it enables the student to get equipped with practical skills, soft skills and life skills

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1** - Observe time/resource management and industrial safety aspects.

**CO2** - Acquire professional experience of industry environment.
**CO3** - Establish effective communication in the working environment.
**CO4** - Prepare a report of assigned activities and accomplishments.

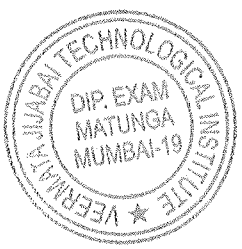
## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

The industry/organization selected for Industrial training/ internships shall be Government/Public Limited/ Private limited / Startup /Centre of Excellence/Skill Centers/Skill Parks etc.

- Duration of Training - 08 weeks students engagement time
- Period of Time slot - Between 4th and 5th semester (08 weeks) i.e. commencement of internships will be immediately following the 4th semester exams.
- Industry area - Engineering Programme Allied industries of large, medium or small-scale, Organization/Govt./ Semi Govt Sectors.

## V. ROLES AND RESPONSIBILITIES OF STUDENTS:

1. Students may interact with the mentor to suggest choices for suitable industry, if any. If students have any contact in industry through their parents or relatives then the same may be utilized for securing placement for themselves and their peers.
2. Students have to fill the forms/formats duly signed by institutional authorities along with a training letter and submit it to a training officer/mentor in the industry on the first day of training.
3. Students must carry with him/her Identity card issued by the institute during the training period.
4. Students should follow industrial dressing protocols, if any. In absence of specific protocol students must wear college uniform compulsorily.
5. Students will have to get all necessary information from the training officer/mentor at industry regarding schedule of training, rules and regulation of the industry and safety norms to be followed. Students are expected to observe these rules, regulations and procedures.
6. Students must be fully aware that if they disobey any rule of industry or do not follow the discipline then non-disciplinary action will be taken .
7. Students must maintain a weekly diary (**Format 6**) by noting daily activities undertaken and get it duly signed from industry mentor or Industrial training in charge.
8. In case students face any major problems in industry such as an accident or any disciplinary issue then they should immediately report the same to the mentor at the institute.
9. Prepare a final report about the training for submitting to the department at the time of presentation and viva-voce and get it signed from a mentor as well as industry training in charge.
10. Students must submit the undertaking as provided in **Format 5**.



## V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

| Sr. No. | Laboratory Experiment / Practical Titles/ Tutorial Titles | Nos. of hours | Relevant COs |
|---|---|---|---|
| 1 | NOT APPLICABLE | | |

## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

**Micro Project (if any)**

## VII. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- 

**Summative Assessment (Assessment of Learning)**

- Presentation

## VIII. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | | 2 | | - | 3 | 3 | 3 | 3 | 2 |
| CO2 | | 2 | | - | 3 | 3 | 3 | 3 | 2 |
| CO3 | | 2 | | - | 3 | 3 | 3 | 3 | 2 |
| CO4 | | 2 | | - | 3 | 3 | 3 | 3 | 2 |
| | | | | | | | | | |
| | | | | | | | | | |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE ★ DIP. EXAM MATUNGA MUMBAI-19

| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | : FIFTH |
| COURSE TITLE | : CHEMICAL REACTION KINETICS |
| COURSE CODE | : 235CH52 |

## I. TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | 1 | 3 | - | 3.5 | 3 | 30 | 70 | 28 | 100 | 40 | 25 | 10 | 50# | 20 | - | - | 175 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

Chemical reaction engineering is an activity concerned with the exploitation of chemical reactions on a commercial scale. This course seeks to familiarize the students with concepts of rate of reaction, rate expression derivation from reaction mechanism by integral method, differential method, and half-life method of analysis. Its goal is the successful design and operation of chemical reactors. Knowledge of the course helps in selecting the optimum reactor design for any process by considering the reaction's kinetics, heat and mass transfer effects, and the economics of the process.

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1** – Analyze the kinetics of various chemical reactions.
**CO2** – Determine the reaction order by interpreting data from constant volume batch reactors.

**CO3** – Determine the reaction order by interpreting data from variable volume batch reactors.
**CO4** – Estimate reactor size using design equations for chemical reactors.
**CO5** – Select the most suitable type of reactor to achieve optimal reactant conversion.
**CO6** – Choose appropriate catalysts to improve reaction rates.

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| SECTION - I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **1** | | **Kinetics of Homogeneous Reactions** | **8** | **10** | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Concept of chemical kinetics, parameters affecting the rate of reaction. | | | | | | |
| | 1.2 | Types of Reaction (Definition and examples): Homogenous and Heterogeneous reactions, Catalytic noncatalytic reactions, Molecularity of reaction, Exothermic and endothermic reactions, Order of reaction, Reversible and irreversible reactions, Elementary and non-elementary reaction, Chain and non-chain reaction. | | | | | | |
| | 1.3 | Reaction rate, rate equation, rate constant, units of rate constant, concentration dependent term of rate equation. | | | | | | |
| | 1.4 | Kinetics of non-elementary reactions (homogeneous reaction) | | | | | | |
| | 1.5 | Activation energy and its significance and numerical. | | | | | | |
| | 1.6 | Derive temperature dependency of rate constant from: Arrhenuis law, Transition state theory, Collision Theory, Compare Arrhenuis, Transition state theory and Collision Theory (Numerical) | | | | | | |
| **2** | | **Constant Volume Batch Reactor** | **10** | **15** | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Concept of constant volume batch reactor and variable volume batch reactor | | | | | | |
| | 2.2 | Constant Volume Batch Reactor: Relation between concentration and conversion for constant volume system | | | | | | |
| | 2.3 | Methods of analysis of kinetic data/rate data: Integral method, differential method, half-life | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | method, Ostwald isolation method and initial rate method | | | | | | |
| | 2.4 | General procedure for integral method for analysis of kinetic data for constant volume reactor a. Integrated rate expression for Irreversible unimolecular type first order reactions and its characteristics b. Integrated rate expression for irreversible bimolecular type second order reactions (2A→ Product and A+B→ Product) and its characteristics c. Integrated rate expression for zero order reaction and its characteristics d. Integrated rate expression for nth order reaction (Numerical) | | | | | | |
| **3** | | **Variable Volume Batch Reactor** | **06** | **10** | **3** | **20%** | **30%** | **50%** |
| | **3.1** | Variable Volume Batch Reactor to Analyse the Kinetic Data/Rate Data: a. b. c. | | | | | | |
| | **3.2** | Concept of εA, Integrated rate expression for irreversible unimolecular type first order reaction | | | | | | |
| | **3.3** | Integrated rate expression for irreversible bimolecular type second order reactions (2A → Product) d. Integrated rate expression for zero order reaction (Numerical) | | | | | | |

| **SECTION - II** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **4** | | **Reactor Design** | **10** | **10** | **4** | **20%** | **30%** | **50%** |
| | 4.1 | Classification of Reactors (diagram, brief description and applications): Batch, semi-batch, continuous stirred tank reactor, tubular/plug flow, fixed bed and fluidised bed reactor | | | | | | |
| | 4.2 | Performance/design equation for ideal batch reactor for constant and variable volume system with their graphical representation. (Numerical) | | | | | | |
| | 4.3 | Concept of space time, space velocity, holding time for flow reactors. (Numerical) | | | | | | |
| | 4.4 | Performance/design equation for steady state continuous stirrer tank reactor (CSTR) for constant | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | and variable volume system with their graphical representation. (Numerical) | | | | | | |
| | 4.5 | Performance/design equation for steady state Plug flow reactor (PFR) for Constant and variable volume system with their graphical representation. (numerical) | | | | | | |
| **5** | | **Design for single reactions** | **8** | **10** | **5** | **20%** | **30%** | **50%** |
| | 5.1 | Size comparison of single reactors, advantages and disadvantages of mixed flow, plug flow and batch reactor | | | | | | |
| | 5.2 | Multiple reactors systems, CSTR's in series and parallel, same and different size CSTR's in series, PFR in series and parallel, different types of reactors in series | | | | | | |
| **6** | | **Catalysis** | **6** | **15** | **6** | **20%** | **30%** | **50%** |
| | 6.1 | Definition of catalysis, characteristics of catalytic reaction | | | | | | |
| | 6.2 | Classification of catalytic reaction: homogeneous and heterogeneous | | | | | | |
| | 6.3 | Properties of catalyst: Activity, specificity, porous and crystalline structure, kindling point | | | | | | |
| | 6.4 | Methods of catalyst preparation: Precipitation, Gel formation, Simple mixing of components, Impregnation. | | | | | | |
| | 6.5 | Mechanism of solid gas phase catalytic reactions | | | | | | |
| | 6.6 | Concept of catalyst deactivation, Concept of Promoters, Inhibitors and Accelerators, Catalyst Poisoning: Deposited poison, chemisorbed poison, selectivity poison, diffusion poison, stability poison. | | | | | | |
| | 6.7 | Catalyst regeneration | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy). | | | | | | | | |

## V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

| Sr. No. | Laboratory Experiment / Practical Titles/ Tutorial Titles | Nos. of hours | Relevant COs |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | Determination of activation energy of saponification of ethyl acetate and sodium hydroxide at various temperatures. | 3 | 1 |
| 2 | Determination of the activation energy of the reaction by hydrolysis of methyl acetate at various temperatures. | 3 | 1 |
| 3 | Determination of Arrhenius rate constants for acidic hydrolysis of methyl acetate at various temperatures. | 3 | 1 |
| 4 | Determination of Arrhenius rate constant for acidic hydrolysis of ethyl acetate at various temperatures. | 3 | 1 |
| 5 | Determination of the rate constant for the saponification reaction of ethyl acetate and sodium hydroxide. | 3 | 1 |
| 6 | Determination of order of reaction for saponification of ethyl-acetate with sodium hydroxide. | 3 | 2 |
| 7 | Determination of the order of reaction for acidic hydrolysis of methyl acetate. | 3 | 2 |
| 8 | Determination of the kinetics of the reaction between ethyl acetate and sodium hydroxide in an isothermal batch reactor. | 3 | 4 |
| 9 | Determination of the kinetics of saponification of ethyl acetate and sodium hydroxide in a Plug Flow Reactor. | 3 | 4 |
| 10 | Determination of the kinetics of saponification of ethyl acetate and sodium hydroxide in a continuous stirrer tank reactor. | 3 | 4 |
| 11 | Determination of rate constant by the half-life period of the saponification reaction between ethyl acetate and sodium hydroxide in an isothermal batch reactor. | 3 | 4 |
| 12 | Determination of kinetics of Bio-diesel synthesis from vegetable oils by Transesterification | 3 | 4 |
| 13 | The performance of three equal volumes of CSTR's in series for the saponification of ethyl acetate and sodium hydroxide reactions. | 3 | 5 |
| 14 | Determination of the void volume of a catalyst particle. | 3 | 6 |
| 15 | Determination of the solid density of a catalyst particle. | 3 | 6 |
| 16 | Determination of the porosity of a catalyst particle. | 3 | 6 |

## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

**Micro Project (if any)**

- **Fabricate tube sheet:** Fabricate tube sheet with triangular pitch arrangement and square pitch arrangement, double pipe heat exchanger.
- **Prepare a model:** Prepare a model of Double pipe heat exchanger, Shell and tube heat exchanger and its types -Fixed tube sheet, Floating head, U tube, Kettle/ Reboiler,1-2, and 2-4 shell and tube exchangers exchanger, Plate type heat exchanger, and finned tube/extended surface heat exchanger (any one).
- **Prepare a model:** Prepare a model of open pan evaporator, multiple effect evaporator, horizontal tube, short tube vertical/ Calandria type, and long tube vertical (any one).
- **Industrial visit**: Prepare a report on heat transfer equipment used in the industry.

## VII. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam, End Term Practical Examination

## VIII. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 |
| CO3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 |
| CO6 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 1 |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## IX. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr. No | Author | Title | Publisher |
|---|---|---|---|
| 1 | Octave Levenspiel | Chemical Reaction Engineering | Wiley India, New Delhi, 2015 ISBN-978-81-265-1000-9 |
| 2 | J. M. Smith | Chemical Engineering Kinetics | Mc-Graw Hill New Delhi, 2015 ISBN007*066574-5 |
| 3 | H. Scott Fogler | Elements of Chemical Reaction Engineering | Pearson New Delhi, 2015 ISBN 978-81-317-1430-0 |
| 4 | Srivastav R. P.S. | Elements of Chemical Reaction Engineering | Khanna Publishers, New Delhi, 2015 ISBN 81-7409-083-5 |

## X. LEARNING WEBSITES & PORTALS

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | https://onlinecourses.nptel.ac.in/noc19_ch20/preview | Chemical Reaction Engineering |
| 2 | https://nptel.ac.in/courses/103/103/103103153/ | Chemical Reaction Engineering |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE DIP. EXAM MATUNGA MUMBAI-19

| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | : FIFTH |
| COURSE TITLE | : HEAT TRANSFER AND APPLICATIONS |
| COURSE CODE | : 235CH53 |

## I. TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | 1 | 3 | - | 3.5 | 3 | 30 | 70 | 28 | 100 | 40 | 25 | 10 | 50# | 20 | - | - | 175 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

This course intends to measure the amount of heat exchanged during the processes and operations. The concept and principles of heat transfer is necessary for the efficient and economical operation of chemical plant. Furthermore, heat transfer equipment also has a significant impact on energy conservation. Optimal selection of heat exchanger equipment enhances the effectiveness of the plant. Using the concepts of conduction, convection and radiation heat losses through pipes and equipment can be estimated.

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1** – Calculate the rate of heat transfer through conduction.
**CO2** – Determine the overall heat transfer coefficient using convection principles.
**CO3** – Apply the concept of radiation in heat transfer.

**CO4** – Choose suitable heat exchanger equipment for a given application.
**CO5** – Estimate the capacity of an evaporator based on the evaporation process.

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| SECTION - I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **1** | | **Conduction** | **10** | **15** | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Introduction to Modes of heat transfer. | | | | | | |
| | 1.2 | Fourier's law of heat conduction: Mathematical equation, Numerical. | | | | | | |
| | 1.3 | Concept of conductors and insulators, Characteristics of insulating materials and optimum thickness of insulation. | | | | | | |
| | 1.4 | Introduction to Thermal conductivity: Mathematical equation, Unit, Equation of relationship between thermal conductivity and temperature, thermal conductivity of materials (metal, non-metal) | | | | | | |
| | 1.5 | Concept of Steady state and unsteady heat transfer. | | | | | | |
| | 1.6 | Steady state heat transfer by conduction: Plane wall, Composite wall, Thick wall hollow cylinder, and Hollow sphere, Numerical. | | | | | | |
| **2** | | **Convection** | **14** | **20** | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Convection and its types. | | | | | | |
| | 2.2 | Individual and overall and heat transfer coefficients: Derivation, Numerical, Concept of fouling factor. | | | | | | |
| | 2.3 | Dimensional analysis to heat transfer by convection. | | | | | | |
| | 2.4 | Sieder - Tate and Dittus-Boelter equations for calculating heat transfer coefficients in laminar and turbulent flow, Numerical. | | | | | | |
| | 2.5 | Flow arrangement in heat exchangers, Log mean temperature difference (LMTD), Numerical. | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2.6 | Heat transfer in condensation: Types, equation for film wise condensation on a vertical surface, equation for film wise condensation on a horizontal tube. | | | | | | |
| | | | | | | | | |

| SECTION - II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **3** | | **Radiation** | **6** | **10** | **3** | **20%** | **30%** | **50%** |
| | 3.1 | Concept of radiation. | | | | | | |
| | 3.2 | Introduction of absorptivity, reflectivity, transmissivity, Emissivity, Total emissive power, Monochromatic emissive power, monochromatic emissivity, Black body, and Gray body. | | | | | | |
| | 3.3 | Kirchhoff's laws and its equation. | | | | | | |
| | 3.4 | Laws of radiation: Stefan-Boltzmann law, Plank's law, Wien's displacement law, Numerical on unlagged steam pipe using Stefan-Boltzmann law. | | | | | | |
| **4** | | **Heat Exchanger Equipments** | **8** | **10** | **4** | **20%** | **30%** | **50%** |
| | 4.1 | Heat transfer equipment and its types, Selection of appropriate heat exchanger equipment. | | | | | | |
| | 4.2 | Double pipe heat exchanger: Diagram, Construction, Working. | | | | | | |
| | 4.3 | Shell and tube heat exchanger and its types - Fixed tube sheet, Floating head, U tube, Kettle/ Reboiler,1-2, and 2-4 shell and tube exchangers: Diagram, Construction, Working. | | | | | | |
| | 4.4 | Plate type heat exchanger, and finned tube/extended surface heat exchanger: Diagram, Construction, working and application. | | | | | | |
| **5** | | **Evaporation** | **12** | **15** | **5** | **20%** | **30%** | **50%** |
| | 5.1 | Introduction to Evaporation, Comparison of evaporation with drying, Effect of properties of solution on evaporation process. | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 5.2 | Performance of evaporator: Capacity and economy. | | | | | | |
| | 5.3 | Methods to improve economy of evaporators: Multiple effect evaporator (Forward feed, backword feed, and mixed feed) and vapour recompression (Mechanical and thermal). | | | | | | |
| | 5.4 | Material and enthalpy balance over single effect evaporator. Numericals. | | | | | | |
| | 5.5 | Open pan (Jacketed pan), Horizontal tube, short tube vertical/ Calandria type, long tube vertical, forced circulation: Diagram Construction, and working and its application. | | | | | | |
| | | | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy). | | | | | | | | |

## V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

| Sr. No. | Laboratory Experiment / Practical Titles/ Tutorial Titles | Nos. of hours | Relevant COs |
|---|---|---|---|
| 1 | Determination of the thermal conductivity of metal rod. | 3 | 1 |
| 2 | Determination of the thermal conductivity of composite wall. | 3 | 1 |
| 3 | Determination of the thermal conductivity of fluid. | 3 | 1 |
| 4 | Determination of the heat transfer coefficient in natural convection. | 3 | 2 |
| 5 | Determination of the heat transfer coefficient in forced convection. | 3 | 2 |
| 6 | Determination of Stefan Boltzman Constant. | 3 | 3 |
| 7 | Determination of the emissivity of given material | 3 | 3 |
| 8 | Determination of the overall heat transfer coefficient in double pipe heat exchanger. | 3 | 4 |
| 9 | Determination of the overall heat transfer coefficient in finned tube heat exchanger. | 3 | 4 |
| 10 | Determination of the overall heat transfer coefficient in shell and tube heat exchanger. | 3 | 4 |
| 11 | Determination of the capacity of open pan evaporator. | 3 | 5 |
| 12 | Determination of capacity and steam economy of single effect evaporator. | 3 | 5 |

## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

**Micro Project (if any)**

- **Fabricate tube sheet:** Fabricate tube sheet with triangular pitch arrangement and square pitch arrangement, double pipe heat exchanger.
- **Prepare a model:** Prepare a model of Double pipe heat exchanger, Shell and tube heat exchanger and its types -Fixed tube sheet, Floating head, U tube, Kettle/ Reboiler,1-2, and 2-4 shell and tube exchangers exchanger, Plate type heat exchanger, and finned tube/extended surface heat exchanger (any one).
- **Prepare a model:** Prepare a model of open pan evaporator, multiple effect evaporator, horizontal tube, short tube vertical/ Calandria type, and long tube vertical (any one).
- **Industrial visit**: Prepare a report on heat transfer equipments used in the industry.

## VII. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam, End Term Practical Examination

## VIII. SUGGESTED COS - POS MATRIX FORM

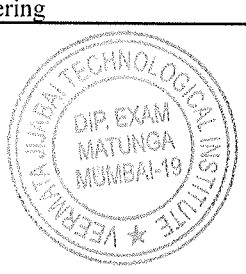
| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 |
| CO3 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 |
| CO4 | 3 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 1 |
| CO5 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| CO6 | | | | | | | | | |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## IX. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr. No | Author | Title | Publisher |
|---|---|---|---|
| 1 | McCabe, Warren L.,Julian C. Smith | Unit Operations of Chemical Engineering | McGraw Hill Publication, New York 2004 (Seventh Edition) ISBN-13:9780072848236 |
| 2 | L. Badger, Julius T. Banchero | Introduction to Chemical Engineering | McGraw Hill Publication, New York 2004 (Seventh Edition) ISBN-10:0073104450 |



| | | | |
|---|---|---|---|
| 3 | Ghosal Salil k. | Introduction to chemical engineering | Tata McGraw Hill Publication, New Delhi, (Reprint2006) ISBN -10:0074601407 |
| 4 | Gupta & Prakash | Engineering heat transfer | Nem Chand & Brothers, New Delhi, 1999 (Seventh Edition) ISBN-10:8185240728 |
| 5 | | | |

## X. LEARNING WEBSITES & PORTALS

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | https://digimat.in/nptel/courses/video/103101137/L01.html | Introduction to heat transfer |
| 2 | https://digimat.in/nptel/courses/video/103105140/L01.html | Introduction to heat transfer |
| 3 | https://www.digimat.in/nptel/courses/video/103101137/L57.html | Log mean temperature difference |
| 4 | https://www.youtube.com/watch?v=cLFCtb4uT4o | Conduction |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE DIP. EXAM MATUNGA MUMBAI-19

| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | :V |
| COURSE TITLE | :CHEMICAL ENGINEERING DRAWING & DESIGN |
| COURSE CODE | :235CH54 |

## I.TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 2 | - | 3 | - | 2.5 | 3 | 30 | 70 | 40 | 100 | 40 | 25 | 10 | 25 | 10 | -- | -- | 150 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

The awareness of different chemical equipments with its details and assembly is essential to diploma Chemical Engineer. Subject includes the drawings of various equipments like Heat exchangers, reactors, storage vessels, distillation columns, valves and fittings etc. and process flow sheet, utility line diagram, instrumentation diagram, various control schemes. As the drawing is a language of engineers, Diploma chemical engineer will be able to express their thoughts and ideas for arranging the various equipment in a particular pattern according to the requirement of process and prepare their drawings using CAD software..

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1** – Use basic operating tools in CAD software.
**CO2** – Use CAD software to draw equipment symbols used in chemical plants
**CO3** – Draw different pipe fittings, joints and valves used in the chemical process industry.
**CO4** – Draw different types of supports used in chemical process industry .
**CO5** – Draw assembly of different equipment used in the chemical process industry..

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| SECTION - I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **COS** | **R Level** | **U Level** | **A Level** |
| **1** | | **Symbols** | **7** | **10** | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Symbols for unit operations | | | | | | |
| | 1.2 | Symbol for instrumentations, valves as per IS 3232 | | | | | | |
| **2** | | **Valves/Fittings** | **6** | **12** | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Applications of valves, drawing of gate valve, globe valve, diaphragm valve, butterfly valve, globe valve | | | | | | |
| | 2.2 | Common fittings: bend, elbow, nipple, socket, reducer, expander, union, tee | | | | | | |
| | 2.3 | Flange joint: welded neck type, screw flange type, Identify relevant pipe joints for given situation, types of support | | | | | | |
| 3. | | **CAD for Chemical Equipment symbols** | **7** | **10** | **3** | **20%** | **30%** | **50%** |
| | 3.1 | Use of relevant drawing command for given assignments | | | | | | |
| | 3.2 | Identify grips editing commands in the given situation with justification . | | | | | | |
| | 3.3 | Select the relevant modify commands and procedure to use those in the given situation with justification. | | | | | | |

| SECTION – II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **4** | | **Design of Shell and Tube Heat exchanger** | **5** | **13** | **4** | **20%** | **30%** | **50%** |
| | 3.1 | No. of passes, concept of pitch, baffles | | | | | | |
| | 3.2 | Calculation of LMTD, overall heat transfer coefficient. | | | | | | |
| | 3.3 | Calculation of Area of HT required. | | | | | | |
| | 3.4 | Drawing of Shell and Tube H. E. | | | | | | |
| **5** | | **Drawing of unit operations** | **5** | **15** | **5** | **20%** | **30%** | **50%** |
| | 4.1 | Drawing of Reactor: CSTR, jackets coils | | | | | | |
| | 4.2 | Distillation column and its packing | | | | | | |
| **6** | | **Process flow diagram** | **2** | **10** | **6** | **20%** | **30%** | **50%** |
| | 5.1 | Process flow diagram, Instrumentation diagram | | | | | | |
| | 5.2 | Utility Diagram | | | | | | |
| | 5.3 | Plant layout | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms' Revised Taxonomy). | | | | | | | | |

## V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

| Sr. No. | Laboratory Experiment / Practical Titles/ Tutorial Titles | Nos. of hours | Relevant COs |
|---|---|---|---|
| 1. | Drawing Of Valve | 3 | 1 |
| 2 | Drawing of different symbol's for unit operation | 3 | 1 |
| 3. | Drawing of joint | 3 | 2 |
| 4. | Design of shell and Tube H.E | 3 | 2 |
| 5. | Drawing of CSTR | 3 | 3 |
| 6. | Drawing of Distillation Column | 3 | 4 |
| 7. | Drawing of plant layout | 3 | 4 |
| 8. | Drawing Of PFD & P&ID | 3 | 4 |

## VI. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam, End Term Practical Examination

## VII. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO2 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO3 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO4 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO5 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VIII. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr. No | Author | Title | Publisher |
|---|---|---|---|
| 1 | M.V.Joshi , V.V Mahajani | Process Equipment Design | Laxmi Publication |
| 2 | Dawande | Procees equipment Design | Deneett & co |
| 3 | B.I.Bhatt , S.B.Thakore | Introduction to process Engineering & Design | Mc Graw Hill . |

## IX. LEARNING WEBSITES & PORTALS

| Sr. No | Link / Portal |
|---|---|
| 1 | http .//nptel.ac.in/courses//103103027/ |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

| | |
|---|---|
| **DIPLOMA PROGRAMME** | **: DIPLOMA IN CHEMICAL ENGINEERING** |
| **PROGRAMME CODE** | **: DCHE** |
| **SEMESTER** | **: V** |
| **COURSE TITLE** | **: INDUSTRIAL MANAGEMENT** |
| **COURSE CODE** | **: 235CH55** |

## I.TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | - | 1 | 2 | 3 | 30 | 70 | 40 | 100 | 40 | 25 | 10 | - | - | 25 | 10 | 150 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

The dynamic nature of the chemical industry demands professionals who not only possess strong technical knowledge but also understand the principles of management and finance. The course "Industrial Management & Finance in Chemical Engineering" bridges the gap between engineering and business, equipping future chemical engineers with the tools to effectively manage industrial operations, optimize processes, and make financially sound decisions.

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1** – Understand the process of industrial finance and its management ..

**CO2** – Know the management aspects of the organization.
**CO3** – Describe the latest trends in industrial management ..
**CO4** – Understand the organisation and its ownership concepts.

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| SECTION - I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **COS** | **R Level** | **U Level** | **A Level** |
| **1** | | **Introduction to Industry** | **8** | **12** | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Meaning-Definition | | | | | | |
| | 1.2 | Types of Industry | | | | | | |
| | 1.3 | Engineering industry | | | | | | |
| | 1.4 | Process industry | | | | | | |
| | 1.5 | Textile industry | | | | | | |
| | 1.6 | Chemical industry | | | | | | |
| | 1.7 | Agro industry | | | | | | |
| | 1.8 | IT industry | | | | | | |
| | 1.9 | Banking, Insurge, Retail, Hospitality, Health Care. | | | | | | |
| | 1.10 | Types of Ownership of Industry: Proprietorship, Partnership, Private Ltd Company, | | | | | | |
| | | Public Ltd Company, Co-operative Enterprises, Public Sector Enterprises | | | | | | |
| **2** | | **Management** | **10** | **10** | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Introduction to management | | | | | | |
| | 2.2 | Principles of management. | | | | | | |
| | 2.3 | Meaning, definition and importance. | | | | | | |
| | 2.4 | Relevance of management to engineers. | | | | | | |
| | 2.5 | Resources of management | | | | | | |

| Unit & Sub-Unit | | Topics/Sub-topics | Hours | Marks | CO | R Level | U Level | A Level |
|---|---|---|---|---|---|---|---|---|
| **3** | | **Supervisor & Supervision** | **7** | **13** | **3** | **20%** | **30%** | **50%** |
| | 3.1 | Meaning and definition | | | | | | |
| | 3.2 | Role and Responsibilities of supervisor | | | | | | |
| | 3.3 | Qualities of Supervisor | | | | | | |
| | 3.4 | Skills of Supervisor | | | | | | |
| **SECTION – II** | | | | | | | | |
| **4** | | **Quality Management** | **8** | **12** | **4** | **20%** | **30%** | **50%** |
| | 4.1 | Meaning of Quality Management System -Activities,...2 | | | | | | |
| | 4.2 | Benefits Quality Control – Objectives, Functions, Advantages Quality Circle-Concept | | | | | | |
| | 4.3 | Characteristics & Objectives Quality Assurance System Concept | | | | | | |
| | 4.4 | Meaning of Total Quality and TQM Components of TOM-Concept. | | | | | | |
| | 4.5 | Elements of TQM, Benefits | | | | | | |
| | 4.6 | Modern Technique: Systems of Quality Management like Kaizen, 5'S',6 Sigma, ISO 9001:2000-Benefits, Main clauses | | | | | | |
| **5** | | **Financial Management** | **5** | **10** | **5** | **20%** | **30%** | **50%** |
| | 5.1 | Capital Generation | | | | | | |
| | 5.2 | Types of Capitals – Fixed & Working Capital | | | | | | |
| | 5.3 | Sources of raising Capital | | | | | | |
| | 5.4 | Features of Short term, Medium Term, Long Term Sources | | | | | | |
| | 5.5 | Types of Budgets. Fixed & Variable Budget-Concept | | | | | | |
| | 5.6 | Production Budget – Sample format | | | | | | |
| | 5.7 | Profit & Loss Account, Balance Sheet- Meaning sample format | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 5.8 | Meaning of different terms involved Excise Tax, Service Tax | | | | | | |
| | 5.8 | Income Tax Value Added Tax, Custom Duty) | | | | | | |
| 6 | | **Cost and cost calculation** | **10** | **13** | **6** | **20%** | **30%** | **50%** |
| | 6.1 | Objectives of cost calculation. | | | | | | |
| | 6.2 | Classification of cost | | | | | | |
| | 6.3 | Variable and fixed cost | | | | | | |
| | 6.4 | Direct and indirect cost | | | | | | |
| | 6.5 | Functional cost | | | | | | |
| | 6.6 | Cost control and cost reduction | | | | | | |
| | 6.7 | Overheads and types of overheads | | | | | | |
| | 6.8 | Cost calculation of a product | | | | | | |
| | 6.9 | Break even analysis | | | | | | |
| | 6.10 | Depreciation calculation. | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms' Revised Taxonomy). | | | | | | | | |

## V. LABORATORY / LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES

| Sr. No. | Laboratory Experiment / Practical Titles/ Tutorial Titles | Nos. of hours | Relevant COs |
|---|---|---|---|
| 1 | What are the types of industries, give five examples of each type. | 2 | 1 |
| 2 | What are the advantages of private limited company over other types of companies | 2 | 2 |
| 3 | Write the management structure for large scale companies. | 2 | 2 |
| 4 | Write role of supervisor. | 2 | 3 |
| 5 | Write the elements of Total quality management for | 2 | 4 |
| 6 | Compare between six sigma and ISO 9001 | 2 | 5 |
| 7 | Prepare and explain balance sheet for reliance industries limited or equivalent industry | 2 | 5 |
| 8 | Calculate depreciation by various methods for various chemical engineering equipments | 2 | 6 |

## VI.ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam, End Term Practical Examination

## VII. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO2 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO3 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO4 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VII.SUGGESTED LEARNING MATERIALS / BOOKS

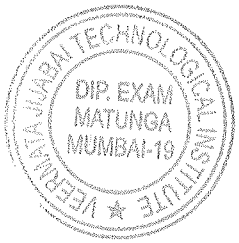
| Sr. No | Author | Title | Publisher |
|---|---|---|---|
| 1 | O.P.Khanna | Industrial Management | Dhanpat Rai & Sons , 5 th Edition ,2012 |

## VII.LEARNING WEBSITES & PORTALS

| Sr.No | Link / Portal |
|---|---|
| 1 | https://nptel.ac.in/courses/112107142/ |
| 2 | https://nptel.ac.in/courses/112107143 |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024



| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | : FIFTH |
| COURSE TITLE | : NUMERICAL METHODS IN CHEMICAL ENGINEERING |
| COURSE CODE | : 235CH56 |

## I. TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | - | - | 1.5 | 3 | 30 | 70 | 28 | 100 | 40 | - | - | - | - | - | - | 100 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

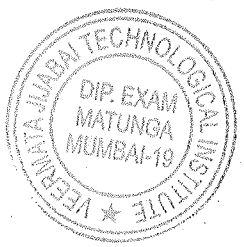
**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

Chemical engineering problems often involve complex equations that are difficult or impossible to solve analytically. Numerical methods provide practical and efficient techniques for solving these problems using computers. This subject introduces students to a variety of numerical techniques such as solving algebraic and differential equations, performing numerical integration, and applying matrix methods. The course further explores applications in optimization, data science, simulation, and process modeling—essential in modern chemical industries. By learning these methods, students will be well-equipped to tackle real-world engineering problems using computational tools, thereby enhancing their analytical skills and employability in design, control, and research-based roles.

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning



**CO1:** Understand the fundamental concepts of numerical methods and recognize their scope and importance in chemical engineering applications.
**CO2:** Apply numerical methods such as Gauss elimination, Gauss-Seidel, and matrix inversion to solve systems of linear equations related to chemical processes.
**CO3:** Implement numerical integration techniques like Trapezoidal and Simpson's rules to evaluate process variables in chemical systems.
**CO4:** Solve algebraic equations using numerical methods such as Bisection, Regula-Falsi, and Newton-Raphson with practical chemical examples.
**CO5:** Use numerical approaches such as Runge-Kutta, Euler's, and Taylor's methods to solve ordinary differential equations arising in chemical engineering models.
**CO6:** Explore advanced numerical techniques including optimization, finite element methods, Monte Carlo simulations, and numerical tools used in simulation software for design and control of chemical processes.

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| SECTION - I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **COS** | **R Level** | **U Level** | **A Level** |
| **1** | | **Introduction to Numerical Methods** | **8** | **10** | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Definition and scope of numerical methods, Importance in solving chemical engineering problems, Difference between analytical and numerical solution. | | | | | | |
| | 1.2 | Use of numerical methods in: Material balance calculations, Reactor design and process modelling, Solving chemical reaction equations | | | | | | |
| | 1.3 | Introduction to computational errors, Round-off error: causes and effects, Truncation error: explanation with examples | | | | | | |
| | 1.4 | Error Measurement and Estimation: Absolute error, Relative error, Percentage error, Importance of error estimation in chemical calculations | | | | | | |
| **2** | | **Numerical Solution of a System for Linear Equations** | **10** | **15** | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Linear equations | | | | | | |
| | 2.2 | Gauss elimination method (Direct Method): Concept, method of application related to chemical engineering processes. | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2.3 | Matrix Inversion: Concept, method related to chemical engineering processes. | | | | | | |
| | 2.4 | Gauss-Seidel iterative method: Concept, method of application related to chemical engineering. | | | | | | |
| | 2.5 | Gauss-Jordan/method: Concept, method of applications related to chemical engineering processes | | | | | | |
| **3** | | **Numerical Integrations** | **06** | **10** | **3** | **20%** | **30%** | **50%** |
| | 3.1 | Numerical Integration Method | | | | | | |
| | 3.2 | Trapezoidal Rule: Concept, method of application applies to chemical engineering processes. | | | | | | |
| | 3.3 | Simpson's 1/3 Rule: Concept, method of application applies to chemical engineering processes. | | | | | | |
| | 3.4 | Simpson's 3/8 Rule: Concept, method of application applies to chemical engineering processes. | | | | | | |

| **SECTION - II** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **4** | | **Numerical solution for Algebraic equation** | **8** | **12** | **4** | **20%** | **30%** | **50%** |
| | 4.1 | Concept of Algebraic equation | | | | | | |
| | 4.2 | Bisection Method: Concept, method of application applies to chemical engineering processes. | | | | | | |
| | 4.3 | Regula-Falsi Method: Concept, method of application applies to chemical engineering processes. | | | | | | |
| | 4.4 | Newton-Raphson Method: Concept, method of application applies to chemical engineering processes. | | | | | | |
| **5** | | **Numerical solution for Ordinary Differential Equation** | **8** | **10** | **5** | **20%** | **30%** | **50%** |

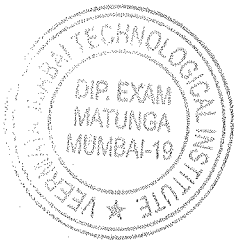
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 5.1 | Concept of Ordinary differential equation | | | | | | |
| | 5.2 | Runge-Kutta Method: For 2nd order differential equation related to chemical engineering processes. | | | | | | |
| | 5.3 | Euler's Method: Error estimate for the Euler's method, Modified Euler's method applies to chemical engineering processes. | | | | | | |
| | 5.4 | Taylor's Series: For 2 order and 4 order differential equation related to chemical engineering processes. | | | | | | |
| **6** | | **Advanced Numerical Techniques and Applications** | **8** | **13** | **6** | **20%** | **30%** | **50%** |
| | 6.1 | Numerical methods in data science and machine learning:<br>Application in data fitting, optimization, and predictive modeling. | | | | | | |
| | 6.2 | Optimization techniques:<br>newton's method and gradient descent for process optimization and parameter estimation in chemical systems. | | | | | | |
| | 6.3 | Finite element method (FEM):<br>basic concept and use in modeling transport phenomena in chemical processes. | | | | | | |
| | 6.4 | Monte Carlo simulations:<br>Introduction and application in uncertainty analysis and simulation. | | | | | | |
| | 6.5 | Numerical methods in process simulation tools overview of numerical methods in software like MATLAB, aspen plus, COMSOL for design and control. | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy). | | | | | | | | |

## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

**Micro Project (if any)**

## VII. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**



- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam

## VIII. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 2 | 2 | - | 3 | - | 2 | 3 | 1 |
| CO2 | 3 | 2 | 2 | - | 3 | - | 2 | 3 | 1 |
| CO3 | 3 | 2 | 2 | - | 3 | - | 2 | 3 | 1 |
| CO4 | 3 | 2 | 2 | - | 3 | - | 2 | 3 | 1 |
| CO5 | 3 | 2 | 2 | - | 3 | - | 2 | 3 | 1 |
| CO6 | 3 | 2 | 2 | 3 | 3 | - | 2 | 3 | 1 |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## IX. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr. No | Author | Title | Publisher |
|---|---|---|---|
| 1 | Steven C. Chapra | Numerical Methods for Engineers | McGraw Hill Education India Private Limited |
| 2 | Kenneth J. Beer | Numerical Methods for Chemical Engineering: Applications in MATLAB | Cambridge University Press |

## X. LEARNING WEBSITES & PORTALS

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | https://nptel.ac.in/courses/127106019 | NPTEL |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | : FIFTH |
| COURSE TITLE | : AGROCHEMICAL TECHNOLOGY |
| COURSE CODE | : 235CH56 |

## I. TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | - | - | 1.5 | 3 | 30 | 70 | 28 | 100 | 40 | - | - | - | - | - | - | 100 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

It provides technologies for agricultural technological processes.

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1:** Basics of Agriculture and agrochemicals
**CO2:** Learn about fertilizer technology
**CO3:** Understand about Pesticide technology
**CO4:** Learn about agrochemical processes
**CO5:** Understand the testing methods of agrochemicals
**CO6:** Learn about environmental impact of agrochemicals and necessity of control

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| SECTION - I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **COS** | **R Level** | **U Level** | **A Level** |
| **1** | | **Introduction to Agriculture and Agrochemicals** | **8** | **10** | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Agriculture: Meaning, scope, and importance in India, | | | | | | |
| | 1.2 | Classification of crops, Role of agrochemicals in modern agriculture | | | | | | |
| | 1.3 | Types of agrochemicals: Fertilizers, Pesticides, Herbicides, Fungicides, Plant Growth Regulator,Agrochemical industry in India: Present status and future prospects | | | | | | |
| **2** | | **Fertilizer Technology** | **10** | **15** | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Plant nutrients and their functions (Macro and Micronutrients) Classification of fertilizers: Organic and Inorganic fertilizers | | | | | | |
| | 2.2 | Manufacturing of Nitrogenous fertilizers (Urea, Ammonium Sulphate) Manufacturing of Phosphatic fertilizers (SSP, DAP) | | | | | | |
| | 2.3 | Manufacturing of Potassic fertilizers (MOP, SOP), Fertilizer storage, handling, and application methods | | | | | | |
| **3** | | **Pesticide Technology** | **06** | **10** | **3** | **20%** | **30%** | **50%** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3.1 | 3.1 Introduction to pesticides and their importance, Classification of pesticides: Insecticides, Herbicides, Fungicides, Rodenticides | | | | | | |
| | 3.2 | Formulations of pesticides (Dust, Granules, Wettable Powder, Emulsifiable Concentrate), Manufacture of selected pesticides (e.g., Malathion, Carbaryl, Glyphosate – concept only) Methods of pesticide application | | | | | | |

| **SECTION - II** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **4** | | **Agrochemical Process Technology** | **10** | **15** | **4** | **20%** | **30%** | **50%** |
| | 4.1 | 4.1 Raw materials used in agrochemical industries, Process flow diagrams of fertilizer and pesticide manufacturing plants, | | | | | | |
| | 4.2 | Unit operations used in agrochemical industries (Mixing, Grinding, Filtration, Drying, Granulation), Equipment used in agrochemical production<br>Packaging and labeling of agrochemical products | | | | | | |
| | 4.3 | Process safety and hazard identification | | | | | | |
| **5** | | **Quality Control and Analysis of Agrochemicals** | **8** | **10** | **5** | **20%** | **30%** | **50%** |
| | 5.1 | 5.1 Importance of quality control in agrochemical industries, Sampling techniques for | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | fertilizers and pesticides,<br>Analysis of fertilizer nutrients (N, P, K) | | | | | | |
| | 5.2 | Quality parameters of pesticides<br>Introduction to analytical instruments (pH meter, UV-Visible Spectrophotometer, Moisture Analyzer) | | | | | | |
| **6** | | **Environmental, Health and Safety Aspects** | **6** | **10** | **6** | **20%** | **30%** | **50%** |
| | 6.1 | Environmental impact of agrochemicals Soil, water, and air pollution due to agrochemicals | | | | | | |
| | 6.2 | Toxicity and health hazards of pesticides and fertilizers, Personal Protective Equipment (PPE) and safety practices | | | | | | |
| | 6.3 | 6.5 Waste management and effluent reatment in agrochemical industries | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy). | | | | | | | | |

## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

**Micro Project (if any)**

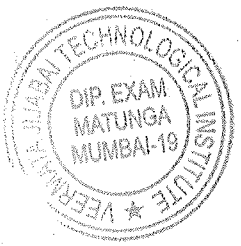
## VII. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam



## VIII. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 1 | - | - | 2 | - | 2 | 2 | 1 |
| CO2 | 3 | 2 | 2 | - | 3 | - | 2 | 2 | 1 |
| CO3 | 3 | 2 | 2 | - | 3 | - | 2 | 2 | 1 |
| CO4 | 3 | 2 | 2 | - | 3 | - | 2 | 2 | 1 |
| CO5 | 3 | 2 | 2 | - | 3 | - | 2 | 2 | 1 |
| CO6 | 3 | 2 | 2 | - | 3 | - | 2 | 2 | 1 |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## IX. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr. No | Author | Title | Publisher |
|---|---|---|---|
| 1 | Dr. Karthika M | Agrochemical: Science, Technology and field applications | wiley |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE DIP. EXAM MATUNGA MUMBAI-19

| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | : V |
| COURSE TITLE | : PHARMACEUTICAL TECHNOLOGY |
| COURSE CODE | : 235CH56 |

## I.TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | - | - | 1.5 | 3 | 30 | 70 | 30 | 100 | 40 | - | - | - | - | - | - | 100 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II.RATIONALE

To acquire a deep-rooted theoretical and practical knowledge of the fundamental principles pharmaceutical formulation. This course provides learning about pharmaceutics, the tools used to prepare pharmaceutical drug and the manufacturing processes used in pharmaceutical production. To acquire a comprehensive understanding of how pharmaceutical dosage forms are developed, manufactured and controlled. The chemical technologists will be able to handle various equipment used in pharmaceutical industries.

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1** – Apply good manufacturing practices in Pharmaceutical Industry.
**CO2** – Use relevant Extraction processes in Pharmaceutical Industry.
**CO3** – Undertake Emulsification and Homogenization process..
**CO4** – Use relevant filtration processes for the desired pharmaceutical product.
**CO5** – Use relevant sterilizer for the process
**CO6** – Use different Active Pharmaceutical Ingredients in pharmaceutical processes.

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| 014SECTION – I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & 1Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **COS** | **R Level** | **U Level** | **A Level** |
| **12** | | **Pharmaceutical Dosage and Extraction** | **8** | **12** | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Explain Dosage form for the given type condition. | | | | | | |
| | 1.2 | Classify the given type of drugs | | | | | | |
| | 1.3 | Describe the specified extraction processes. | | | | | | |
| **2** | | **Emulsification and Homogenization.** | **10** | **13** | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Describe the features of the specified process.. | | | | | | |
| | 2.2 | Explain with sketches the working of the specified process.. | | | | | | |
| | 2.3 | Explain with sketches the given equipment.. | | | | | | |
| **3** | | **Solid Dosage Forms** | **7** | **12** | **3** | **20%** | **30%** | **50%** |
| | 3.1 | Tablets , Types, Manufacturing's , defects , Remedies | | | | | | |
| | 3.2 | Capsule's :- Hard And Soft Gallatin capsules , Filling Techniques. | | | | | | |
| | 3.3 | Powders AND Granule :- preparation and advantage | | | | | | |

| SECTION – II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **4** | | **Filtration Processes** | **8** | **11** | **3** | **20%** | **30%** | **50%** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3.1 | List the relevant factors affecting the rate of filtration with respect to the specified filter media.. | | | | | | |
| | 3.2 | Classify the given filter media and filter aid used for filtration process. | | | | | | |
| | 3.3 | Explain with sketches the specified type of filtration equipment | | | | | | |
| | 3.4 | Describe the features of the specified type of air filtration units. | | | | | | |
| **5** | | **Sterilization** | **5** | **8** | **4** | **20%** | **30%** | **50%** |
| | 4.1 | Describe the need for the specified type of Sterilization. | | | | | | |
| | 4.2 | State the specification of the specified equipment used for sterilization. | | | | | | |
| | 4.3 | Explain with sketches the working of the specified equipment used for sterilization. | | | | | | |
| **6** | | **Active Pharmaceutical Ingredient** | **10** | **14** | **5** | **20%** | **30%** | **50%** |
| | 5.1 | Describe the properties of the given type of Active Pharmaceutical Ingredient. | | | | | | |
| | 5.2 | Draw the flow diagrams of the specified Pharmaceutical Products | | | | | | |
| | 5.3 | Describe the process of the given Pharmaceutical Products | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy). | | | | | | | | |

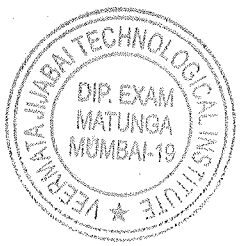
## V. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam, End Term Practical Examination



## VI. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO2 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO3 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO4 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO5 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |
| CO6 | 3 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VII. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr. No | Author | Title | Publisher |
|---|---|---|---|
| 1 | Howard C.Ansel, Nicholas G., Popovich, Lord V. Alien | Pharmaceutical Dosage Form and drug delivery systems | B.I.Waverly Pvt. Ltd., New Delhi, 2015, ISBN: 9780781746120 |
| 2 | Perry Robert H. Green Don W. | Perry's Chemical Engineer's Handbook | McGraw Hill New Delhi 2009 ISBN-13: 9780070498419 |
| 3 | Walter L. Badger, Julius T. Banchero | Introduction to Chemical Engineering | CRC Press, First Edition 2007 ISBN 13: 9780824719814 |
| 4 | Kumar Gadamasetti | Process Chemistry in Pharmaceutical Industry | John Wiley & Sons. Inc Publication New York. ISBN: 0471165166 |

## IX.LEARNING WEBSITES & PORTALS

| Sr. No | Link / Portal |
|---|---|
| 1 | https://www.youtube.com/results?search_query=natural+way+to+prepare+shampoo |
| 2 | e Library: http://202.74.245.22:8080/xmlui/handle/123456789/292 |
| 3 | https://www.fda.gov/downloads/ScienceResearch/FieldScience/UCM397228.pdf |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE DIR. EXAM MATUNGA MUMBAI-19

| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | : FIFTH |
| COURSE TITLE | : BIOCHEMICAL TECHNOLOGY |
| COURSE CODE | : 235CH56 |

## I. TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | - | - | 1.5 | 3 | 30 | 70 | 28 | 100 | 40 | - | - | - | - | - | - | 100 |

*Total IKS Hrs for Sem.: 0 Hrs*

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

Piping Technology develops idea to arrange and optimize the piping facility required for transport of various fluids from one to other unit operations

## III. COURSE OUTCOMES (COS)

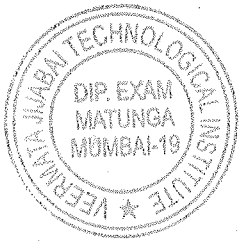
Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1** – Understand the basics genetic engineering
**CO2** – Knowledge of enzymes types and their physiology
**CO3** – knowledge of preparation different tissue culture and their kinetics
**CO4** – To perform basic design of bioreactor
**CO5** – Knowledge of various fermentation processes
**CO6** – Knowledge of application of biochemical engineering

**Course Content:**

| SECTION-I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Unit & Sub-Unit | | Topics/Sub-topics | Hours | Marks | CO | R Level | U Level | A Level |
| 1 | | **Introduction to Biotechnology and Enzyme** | 4 | 5 | 1 | 40% | 40% | 20% |
| | 1.1 | Role of chemical engineers in biotechnology | | | | | | |
| | 1.2 | Basics of Genetic Engineering and Tissue Culture : Recombinant DNA technology | | | | | | |
| 2 | | **Enzymes** | 10 | 15 | 2 | 40% | 40% | 20% |
| | 2.1 | Introduction, Structure function relations of enzymes; Classification | | | | | | |
| | 2.2 | Mechanism of Enzyme action, Enzyme kinetics, inhibition and regulation Enzyme purification and characterization, Coenzymes, cofactors | | | | | | |
| 3 | | **Bioprocess Development** | 10 | 15 | 3 | 40% | 40% | 20% |
| | 3.1 | Plant and animal cell cultures for the production of biochemicals, Enzyme reactors, thermostabilization, Immobilized cells | | | | | | |
| | 3.2 | Kinetics of microbial growth, models and simulations, Batch and continuous culture, Mixed microbial culture | | | | | | |
| **SECTION-II** | | | | | | | | |
| 4 | | **Bioreactor** | 08 | 20 | 4 | 40% | 40% | 20% |
| | 4.1 | Integration of downstream processing with bio-processing. | | | | | | |
| | 4.2 | Reactor design for biochemical reactions and scale up, Process Design for bioproducts, Bioreactor design | | | | | | |
| | 4.3 | Scale up of bioreactions/reactors, | | | | | | |
| 5 | | **Fermentation** | 10 | 15 | 5 | 40% | 40% | 20% |
| | 5.1 | Fundamentals of fermentation-submerged fermentation, | | | | | | |
| | 5.2 | Fermenter design and basic biochemical engineering aspects of fermentation | | | | | | |
| 6 | | **Applications** | 06 | 5 | 6 | 40% | 40% | 20% |
| | 6.1 | Application of biochemical engineering in pharmaceutical, food and fine chemicals | | | | | | |
| | | **Total** | 48 | 70 | | | | |

**Legends:** R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).



## IV. LABORATORY / LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES

| Sr. No. | Laboratory Experiment / Practical Titles/ Tutorial Titles | Nos. of hours | Relevant COs |
|---|---|---|---|
| 1 | Write a note on Recombinant DNA technology | 2 | 1 |
| 2 | What enzymes, write its classification | 2 | 2 |
| 3 | Explain in detail about mechanism of working of enzymes | 2 | 2 |
| 4 | What are the steps for preparation plant and animal tissue culture | 2 | 3 |
| 5 | What is the designing process to design the bioreactor | 2 | 4 |
| 6 | How the fermentation process works, explain in detail. | 2 | 5 |
| 7 | What are the basic bioengineering aspects of fermentation | 2 | 5 |
| 8 | Applications of biochemical engineering in pharmaceutical industry | 2 | 6 |

## V. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES Micro Project (if any)

NA

## *VI.* ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test
- Tutorial

**Summative Assessment (Assessment of Learning)**

- End Term Exam

## *VII.* SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineerin Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 2 | 2 | - | - | - | 2 | 2 | - |
| CO2 | 3 | 2 | 2 | - | - | 1 | 1 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| CO5 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| CO6 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |

Legends: - High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VIII. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr. No. | Author | Title | Publisher and Edition |
|---|---|---|---|
| 1 | D. G. Rao | . Introduction to Biochemical Engineering | McGraw Hill Education; 2 edition (11 August 2009) |

## *IX.* LEARNING WEBSITES & PORTAL*S*

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | https://archive.nptel.ac.in/courses/103/105/103105054/ | NPTEL |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE ★ DIP. EXAM MATUNGA MUMBAI-19

| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | : FIFTH |
| COURSE TITLE | : MATERIAL AND ENERGY BALANCES |
| COURSE CODE | : 235CH56 |

## I. TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | - | - | 1.5 | 3 | 30 | 70 | 28 | 100 | 40 | - | - | - | - | - | - | 100 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

The **Material and Energy Balances** course forms the foundation for understanding and solving practical problems in chemical engineering. It is one of the most important subjects as it applies universally to all chemical processes, whether simple or complex. In the real world, the efficient design, operation, and optimization of chemical processes rely heavily on accurately tracking material and energy flows.

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1:** Understand and apply fundamental laws of conservation of mass and energy.
**CO2:** Solve material balance problems for physical processes without chemical reactions.
**CO3:** Perform material balances involving chemical reactions.

**CO4:** Apply energy balance principles for processes without chemical reactions.
**CO5:** Analyze and calculate energy changes for processes involving chemical reactions.
**CO6:** Perform combined material and energy balances on simple industrial systems.

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| SECTION - I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **COS** | **R Level** | **U Level** | **A Level** |
| **1** | | **Introduction to Material and Energy Balances** | **8** | **10** | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Importance of mass and energy balances. | | | | | | |
| | 1.2 | Units and conversions (SI and English systems). | | | | | | |
| | 1.3 | Basis of calculation, process flow diagrams (PFDs). | | | | | | |
| | 1.4 | Law of conservation of mass and energy. | | | | | | |
| **2** | | **Material Balances Without Chemical Reaction** | **10** | **15** | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Mass balance principles for batch and continuous processes. | | | | | | |
| | 2.2 | Simple material balance problems. | | | | | | |
| | 2.3 | Recycle, bypass, and purge calculations. | | | | | | |
| **3** | | **Material Balances with Chemical Reaction** | **06** | **10** | **3** | **20%** | **30%** | **50%** |
| | 3.1 | Stoichiometry concepts: limiting reactant, excess reactant, conversion, yield, selectivity. | | | | | | |
| | 3.2 | Material balances involving chemical reactions. | | | | | | |
| | 3.3 | Combustion reactions and related material balances. | | | | | | |

| SECTION - II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **4** | | **Energy Balances Without Reaction** | **8** | **12** | **4** | **20%** | **30%** | **50%** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4.1 | Heat capacity, sensible and latent heats. | | | | | | |
| | 4.2 | Enthalpy changes for physical processes: heating, cooling, phase changes. | | | | | | |
| | 4.3 | Energy balances for non-reactive systems. | | | | | | |
| **5** | | **Energy Balances With Chemical Reaction** | **8** | **10** | **5** | **20%** | **30%** | **50%** |
| | 5.1 | Heat of reaction, heat of formation, heat of combustion. | | | | | | |
| | 5.2 | Calculation of energy requirements for chemical reactions. | | | | | | |
| | 5.3 | Adiabatic and non-adiabatic reaction temperature calculations (basic problems). | | | | | | |
| **6** | | **Combined Material and Energy Balances** | **8** | **13** | **6** | **20%** | **30%** | **50%** |
| | 6.1 | Simultaneous mass and energy balances for simple systems. | | | | | | |
| | 6.2 | Introduction to energy efficiency and pinch analysis (basic idea only). | | | | | | |
| | 6.3 | Industrial examples: distillation, evaporation, drying (simple balances). | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy). | | | | | | | | |

## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

**Micro Project (if any)**

## VII. ASSESSMENT METHODOLOGIES/TOOLS

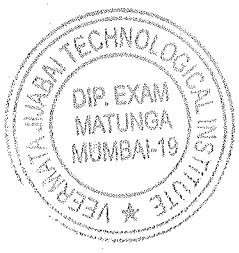
**Formative Assessment (Assessment of Learning)**

- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam

## VIII. SUGGESTED COS - POS MATRIX FORM



| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO2 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO3 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO4 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO5 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO6 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knledge for sustainable development through teamwork and effective communication for lifelong learning.

## IX. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr. No | Author | Title | Publisher |
|---|---|---|---|
| 1 | B.I. Bhatt and S.M. Vora | Stoichiometry | Tata McGraw-Hill |
| 2 | David Mautner Himmelblau, James B. Riggs | Basic Principles and Calculations in Chemical Engineering | Prentice Hall |
| 3 | O.A. Hougen, K.M. Watson, and R.A. Ragatz | Chemical Process Principles (Part 1: Material and Energy Balances) | John Wiley & Sons |
| 4 | | | |

## X. LEARNING WEBSITES & PORTALS

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | https://www.udemy.com/course/principles-of-chemical-processes-material-energy-balance | Principles of Chemical Processes - Mass & Energy Balance |
| 2 | https://onlinecourses.nptel.ac.in/noc23_bt16/preview | Material and Energy Balances |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE DIP. EXAM MATUNGA MUMBAI-19

| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | : FIFTH |
| COURSE TITLE | : THERMAL SYSTEM DESIGN |
| COURSE CODE | : 235CH56 |

## I. TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | - | - | 1.5 | 3 | 30 | 70 | 28 | 100 | 40 | - | - | - | - | - | - | 100 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

In the chemical industry, **thermal systems** such as **heat exchangers, reboilers, condensers, evaporators, and cooling systems** play a vital role in various unit operations and processes.
Efficient transfer, recovery, and management of heat are essential to **ensure process efficiency, reduce energy consumption, and enhance plant safety and sustainability**. The subject **"Thermal System Design"** is introduced to develop the necessary skills among diploma chemical engineering students to **understand, design, operate, and maintain** thermal equipment commonly used in chemical industries.

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1:** Explain the role and importance of thermal systems in chemical processes.

**CO2:** Identify and describe different types of heat transfer equipment used in chemical industries.
**CO3:** Design basic heat exchangers for process applications using LMTD method.
**CO4:** Analyze and suggest improvements for reboilers and condensers used in chemical operations.
**CO5:** Apply basic concepts of heat recovery and energy integration in chemical plants.
**CO6:** Recommend maintenance practices to optimize thermal systems for efficient and safe operation.

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| SECTION - I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **COS** | **R Level** | **U Level** | **A Level** |
| **1** | | **Fundamentals of Thermal Systems in Chemical Industry** | **8** | **10** | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Importance of thermal systems in chemical processes | | | | | | |
| | 1.2 | Overview: heaters, reboilers, condensers, evaporators | | | | | | |
| | 1.3 | Energy balance in thermal equipment | | | | | | |
| | 1.4 | Need for efficient thermal system design in industries | | | | | | |
| **2** | | **Heat Transfer Equipment in Chemical Plants** | **10** | **15** | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Types of heat exchangers: shell & tube, plate, finned tube | | | | | | |
| | 2.2 | Applications in chemical industries | | | | | | |
| | 2.3 | Concept of overall heat transfer coefficient (U-value) | | | | | | |
| | 2.4 | Basics of fouling and its impact | | | | | | |
| **3** | | **Heat Exchanger Design for Process Applications** | **06** | **10** | **3** | **20%** | **30%** | **50%** |
| | 3.1 | LMTD method (Log Mean Temperature Difference) | | | | | | |
| | 3.2 | NTU-effectiveness method (basic idea) | | | | | | |
| | 3.3 | Sizing of simple heat exchangers | | | | | | |
| | 3.4 | Factors affecting design: flow arrangements, material selection | | | | | | |

| SECTION - II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **4** | | **Design and Operation of Reboilers and Condensers** | **8** | **12** | **4** | **20%** | **30%** | **50%** |
| | 4.1 | Role of reboilers in distillation columns | | | | | | |
| | 4.2 | Condenser types: total and partial condensers | | | | | | |
| | 4.3 | Basic design criteria: duty, temperature profiles | | | | | | |
| | 4.4 | Troubleshooting and performance issues | | | | | | |
| **5** | | **Energy Integration in Chemical Processes** | **8** | **10** | **5** | **20%** | **30%** | **50%** |
| | 5.1 | Concept of heat recovery | | | | | | |
| | 5.2 | Introduction to Pinch Technology | | | | | | |
| | 5.3 | Heat exchanger networks (simple examples) | | | | | | |
| | 5.4 | Case studies: energy savings in chemical plants | | | | | | |
| **6** | | **Thermal System Maintenance and Optimization** | **8** | **13** | **6** | **20%** | **30%** | **50%** |
| | 6.1 | Monitoring thermal systems (temperature, flow, pressure) | | | | | | |
| | 6.2 | Common problems: scaling, leakage, corrosion | | | | | | |
| | 6.3 | Methods of improving thermal efficiency | | | | | | |
| | 6.4 | Importance of insulation and preventive maintenance | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy). | | | | | | | | |

## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

**Micro Project (if any)**

## VII. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam

## VIII. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO2 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO3 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO4 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO5 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |
| CO6 | 3 | 2 | 2 | 2 | 3 | - | 2 | 3 | 1 |

Legends:- High: 03, Medium: 02,Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## IX. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr. No | Author | Title | Publisher |
|---|---|---|---|
| 1 | Donald Q. Kern | Process Heat Transfer | McGraw-Hill Education |
| 2 | James R. Couper, W. Roy Penney, James R. Fair | Chemical Process Equipment: Selection and Design | Butterworth-Heinemann |
| 3 | Robert W. Serth | Process Heat Transfer: Principles and Applications | Academic Press |

## X. LEARNING WEBSITES & PORTALS

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | https://onlinecourses.nptel.ac.in/noc23_me31/preview | Thermal Engineering: Basic and Applied |
| 2 | https://www.cranfield.ac.uk/courses/short/energy-and-sustainability/thermal-system-operation-and-design | Thermal Systems Operation and Design |

**Curriculum Coordinator** **Head of the Department** **Dean Diploma**

BOS VJTI Approval dated 10/07/2024

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| | |
|---|---|
| DIPLOMA PROGRAMME | : DIPLOMA IN CHEMICAL ENGINEERING |
| PROGRAMME CODE | : DCHE |
| SEMESTER | : FIFTH |
| COURSE TITLE | : PROJECT I |
| COURSE CODE | : 235CH57 |

## I. TEACHING AND EXAMINATION SCHEME

| TEACHING SCHEME | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | TL | LL | SL | CR | PAPER HRS | FA-TH (MST) | SA-TH (ESE) | | TOTAL | | Based on LL & TL Practical | | | | Based on Self-learning | | TOTAL MARKS |
| | | | | | | | | | | | FA-PR (CA) | | SA-PR (PR/OR) | | SLA | | |
| | | | | | | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| - | - | 6 | - | 3 | - | - | - | - | - | - | 50 | 20 | 50# | 20 | - | - | 100 |

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination**

**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

The chemical engineering industry constantly seeks innovative, efficient, and sustainable solutions to meet modern challenges such as pollution control, resource recovery, energy optimization, and process safety. As part of the diploma curriculum, Project I provides a valuable opportunity for students to apply theoretical knowledge to real-world applications.

This project is undertaken to develop a practical understanding of core chemical engineering concepts such as reaction engineering, heat and mass transfer, fluid mechanics, or environmental engineering, depending on the chosen topic. Through this project, students learn how to identify problems, design experiments or processes, analyze data, and propose viable technical solutions.

The rationale behind this project lies in strengthening technical problem-solving skills and preparing students for industrial demands by encouraging innovation, teamwork, and analytical thinking. It also

contributes to building a foundation for sustainable engineering practices that are essential for future developments in the chemical industry.

## III. COURSE OUTCOMES (COS)

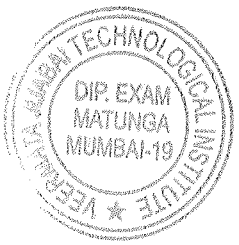
Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1** – Selection and analysis of problem
**CO2** – Literature survey
**CO3** – Generation or gathering of technical data, solution to current problem
**CO4** – Analysis of data and conclusion

## IV. COURSE CONTENTS WITH SPECIFICATION TABLE

| SECTION - I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **COS** | **R Level** | **U Level** | **A Level** |
| **1** | | **Introduction** | **10** | | **1** | **20%** | **30%** | **50%** |
| | 1.1 | Selection of problem, problem statement | | | | | | |
| | 1.2 | History, need to solve the problem | | | | | | |
| **2** | | **Selections of Topics** | **30** | | **2** | **20%** | **30%** | **50%** |
| | 2.1 | Based on real time industrial problems | | | | | | |

| SECTION - II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Unit & Sub-Unit** | | **Topics/Sub-topics** | **Hours** | **Marks** | **CO** | **R Level** | **U Level** | **A Level** |
| **3** | | **Literature Review** | **30** | | **3** | **20%** | **30%** | **50%** |
| | 3.1 | Gathering and analysing literature on concern problem | | | | | | |
| | 3.2 | Finding of probable solutions | | | | | | |
| **4** | | **Seminar** | **26** | | **4** | **20%** | **30%** | **50%** |
| | 4.1 | Presentation on minor project work | | | | | | |
| | | | | | | | | |
| Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy). | | | | | | | | |



## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

**Micro Project (if any)**

## VII. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

**Summative Assessment (Assessment of Learning)**

- Presentation

## VIII. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO- 1 | PSO- 2 |
| CO1 | 3 | 3 | | | 1 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | | 1 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |

Legends: - High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.
PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

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