PPSU

P P SAVANI UNIVERSITY

# SCHOOL OF ENGINEERING

## B. TECH. (CHEMICAL ENGINEERING)

## SYLLABUS BOOK

## AY 2023-24

| INSTITUTE VISION |
|---|
| To emerge as an Institute of Excellence by imparting value-based education aided with Research, Innovation and Entrepreneurial skills. |

| INSTITUTE MISSION | |
|---|---|
| 1. | To impart the holistic engineering education of highest quality & prepare socially responsible professionals with entrepreneurial skills. |
| 2. | To prepare value-aided engineering professionals to meet up global industry requirements by imparting cutting edge professional education. |
| 3. | To inculcate the attitude of research and innovation among the stake holders through experiential and project-based teaching-learning pedagogy. |
| 4. | To acquire global talent pool by providing world class amenities for teaching, learning & research. |

Graduates will demonstrate ability to:

| PEO No | PROGRAMME EDUCATIONAL OBJECTIVES |
|---|---|
| PEO 1 | Solve real-world engineering problems, design and develop innovative and cost-effective solutions exhibiting engineering skills/fundamentals to cater needs of society. |
| PEO 2 | Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting comprehensive competitiveness. |
| PEO 3 | Exhibit professional ethics & values, effective communication, teamwork, multidisciplinary approach, and ability to relate engineering issues to broader societal framework. |

| PO No | PROGRAMME OUTCOMES |
|---|---|
| PO 1 | Engineering knowledge:<br>Apply knowledge of engineering fundamentals, science, mathematics & engineering specialization for the solution of complex engineering problems. |
| PO 2 | Problem analysis:<br>Identify, formulate and analyze complex engineering problems leading to substantial conclusions using basic principles of mathematics, science and engineering. |
| PO 3 | Design/development of solutions:<br>Develop solutions for complex engineering problems and design system components or processes meeting specified needs having due consideration for the safety and societal & environmental considerations. |
| PO 4 | Conduct investigations of complex problems:<br>Use research-based knowledge & methods like design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid & viable conclusions. |
| PO 5 | Modern tool usage:<br>Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools for prediction and modeling of complex engineering activities with an understanding of the limitations. |
| PO 6 | The engineer and society:<br>Apply cognitive learning by the contextual knowledge to assess societal, health, safety, legaland cultural issues and following responsibilities relevant to the professional engineering practice. |
| PO 7 | Environment and sustainability:<br>Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge & skill needed for sustainable development. |
| PO 8 | Values & Ethics:<br>Apply basic moral values & ethical principles and pledge to professional ethics/norms and responsibilities of the engineering practice. |
| PO 9 | Individual and team work:<br>Function effectively as an individual/as a team member or as a leader in diverse teams, andin multidisciplinary settings. |
| PO 10 | Communication:<br>Communicate effectively on complex engineering activities with the engineering communityand with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| PO 11 | Project management and finance:<br>Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments. |
| PO 12 | Life-long learning:<br>Recognize the need, do necessary preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

| PSO No | PROGRAMME SPECIFIC OUTCOMES (PSO)CHEMICAL ENGINEERING |
|---|---|
| PSO 1 | Acquire and apply industry centric skills in the field of Chemical Engineering for the benefit of society. |
| PSO 2 | Develop an attitude to accept global challenges and apply Chemical Engineering knowledge for solving engineering problems related to core and interdisciplinary fields. |
| PSO 3 | Demonstrate and develop the appropriate solutions of the complex level of Chemical Engineering design-based problems to meet the specified needs and overall sustainabilityof the processes, considering the necessary approaches of safety, health hazards, societal and environmental factors. |

| Credit Guidelines (General) | | | |
|---|---|---|---|
| **Component** | **Hour/Week** | **Credit** | **Total Hours/Semester** |
| Theory | 1 | 1 | 15 |
| Practical | 2 | 1 | 30 |
| Tutorial | 1 | 1 | 15 |
| Note: In specific cases; extra credits can be granted for specific/important subjects. | | | |

| CO-PO Mapping Guidelines | | |
|---|---|---|
| **Mapping Level** | **% age Mapping** | **Indicator** |
| 0 / - | 0 | No Mapping |
| 1 | 0-33 | Low Level (Slightly Mapped) |
| 2 | 33-66 | Medium Level (Moderately Mapped) |
| 3 | >66 | High Level (Strongly Mapped) |

# Syllabus Book

# B. Tech. (Chemical Engineering)

**P P Savani University**

School of Engineering

Effective From: 2023-24

Authored by: P P Savani University

# CONTENT

# FIRST YEAR B. TECH.

**P P SAVANI UNIVERSITY**

**SCHOOL OF ENGINEERING**

**TEACHING & EXAMINATION SCHEME FOR B. TECH. BATCH : 2023 (CHEMICAL ENGINEERING)**

| Sem | Course Code | Course Title | Offered By | Teaching Scheme | | | | | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Contact Hours | | | | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | Theory | Practical | Tutorial | Total | | CE | ESE | CE | ESE | CE | ESE | |
| 1 OR 2 | SESH1110 | Calculus | SH | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SESH1120 | Linear Algebra | SH | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SEME1110 | Hardware Workshop | ME | 0 | 4 | 0 | 4 | 4 | 0 | 0 | 100 | 0 | 0 | 0 | 100 |
| | SECE1110 | Software Workshop | CE | 0 | 4 | 0 | 4 | 2 | 0 | 0 | 100 | 0 | 0 | 0 | 100 |
| | SEIT1110 | Cyberspace Awareness | IT | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SEIT1120 | Competitive Quantitative Aptitude | IT | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECE1120 | Joy of Programming | CE | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SESH1130 | Conceptual Experimental Physics | SH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH1110 | Fundamental Chemistry & Environmental Science | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SEME1120 | Fundamentals of Technical Drawing | ME | 0 | 4 | 0 | 4 | 4 | 0 | 0 | 40 | 60 | 0 | 0 | 100 |
| | SECV1110 | Core Engineering Concepts | CV | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | CFLS2130 | Intermediate Communicative English | CFLS | 2 | 2 | 0 | 4 | 3 | 100 | 00 | 100 | 0 | 0 | 0 | 200 |
| | CLSC2070 | Essentials of Entrepreneurship | CFLS/SLM | 2 | 0 | 0 | 2 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | | | | | **Total** | **52** | **45** | | | | | | | **2000** |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group 1** | SESH1110 | Calculus | SH | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SEME1110 | Hardware Workshop | ME | 0 | 4 | 0 | 4 | 4 | 0 | 0 | 100 | 0 | 0 | 0 | 100 |
| | SEIT1110 | Cyberspace Awareness | IT | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SESH1130 | Conceptual Experimental Physics | SH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SEME1120 | Fundamentals of Technical Drawing | ME | 0 | 4 | 0 | 4 | 4 | 0 | 0 | 40 | 60 | 0 | 0 | 100 |
| | SECE1120 | Joy of Programming | CE | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | CFLS2130 | Intermediate Communicative English | CFLS | 2 | 2 | 0 | 4 | 3 | 100 | 0 | 100 | 0 | 0 | 0 | 200 |
| | | | | | | **Total** | **29** | **26** | | | | | | | **1100** |
| **Group 2** | SESH1120 | Linear Algebra | SH | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SECE1110 | Software Workshop | CE | 0 | 4 | 0 | 4 | 2 | 0 | 0 | 100 | 0 | 0 | 0 | 100 |
| | SEIT1120 | Competitive Quantitative Aptitude | IT | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH1110 | Fundamental Chemistry & Environmental Science | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECV1110 | Core Engineering Concepts | CV | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | CLSC2070 | Essentials of Entrepreneurship | CFLS/SLM | 2 | 0 | 0 | 2 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | | | | | **Total** | **23** | **19** | | | | | | | **900** |

**P P Savani University**
**School of Engineering**

**Department of Science and Humanities**

Course Code: SESH1110
Course Name: Calculus
Prerequisite Course/s: Algebra, Geometry, Trigonometry &Pre-Calculus till 12th Standard level

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 3 | 0 | 2 | 5 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the course:**
To help learners to

- summarize concept of calculus to enhance ability of analysing mathematical problems.
- acquire knowledge and ability to work with differentiation and integration for applications of mathematical techniques in engineering.
- develop the tool of convergence or divergence of any infinite series and power series for learning advanced Engineering Mathematics.
- acquire knowledge of partial differentiation and ability to work with applications to advanced Engineering Mathematics.
- application of concavity of graph and find out points of inflection.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Calculus**<br>Limits, Continuity, Types of Discontinuity, Successive Differentiation,Rolle's Theorem, LMVT, CMVT, Maxima and Minima. | 9 | 20 |
| 2. | **Sequence and Series-I**<br>Convergence and Divergence, Comparison Test, Integral Test, Ratio Test, Root Test, Alternating Series, Absolute and Conditional Convergence. | 9 | 20 |
| 3. | **Sequence and Series-II**<br>Power series, Taylor and Macluarin series, Indeterminate forms and L'Hospitals Rule. | 5 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Partial Derivatives**<br>Function of several variables, Partial differentiation, Applications, Chain rule, Linear approximations, Maxima and Minima, Euler's theorem, Lagrange multiplier. | 11 | 30 |
| 2. | **Curve tracing** | 11 | 20 |

| | | | |
|---|---|---|---|
| | Tracing of Cartesian Curves, Polar Coordinates, Polar and Parametric Form of Standard Curves, Areas and Length in Polar co-ordinates | | |

**List of Tutorials:**

| Sr. No. | Name of Tutorial | Hours |
|---|---|---|
| 1. | Calculus-1 | 4 |
| 2. | Calculus-2 | 4 |
| 3. | Calculus-3 | 2 |
| 4. | Sequence and Series-1 | 4 |
| 5. | Sequence and Series-2 | 2 |
| 6. | Sequence and Series-3 | 2 |
| 7. | Partial Derivatives-1 | 4 |
| 8. | Partial Derivatives-2 | 2 |
| 9. | Curve tracing-1 | 4 |
| 10. | Curve tracing-2 | 2 |

**Text Book:**

| Title | Author(s) | Publication |
|---|---|---|
| Thomas' Calculus | George B. Thomas, Maurice D. Weir and Joel Hass | Pearson |
| Elementary linear Algebra | Howard Anton and Chrish Rorres | Wiley |

**Reference Book:**

| Title | Author(s) | Publication |
|---|---|---|
| Advanced Engineering Mathematics | E Kreyszig | John Wiley and Sons |
| A textbook of Engineering Mathematics | N P Bali and Manish Goyal | Laxmi |
| Higher Engineering Mathematics | B S Grewal | Khanna |
| Engineering Mathematics | T Veerarajan | Tata Mc Graw Hill |
| Engineering Mathematics-1 (Calculus) | H. K. Dass and Dr. Rama Verma | S. Chand |

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

**Tutorial:**

- Continuous Evaluation consists of performance of tutorial which will be evaluated out of 10 marks for each tutorial and average of the same will be converted to 50 marks
- Continuous Evaluation consists of self-performance assignment to 20 marks.
- Internal Viva consists of 30 marks.

**Course Outcome(s):**

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

| SESH1110 | CALCULUS |
|---|---|
| CO 1 | Recall the concepts of limit, continuity and differentiability for analysing mathematical problems. |
| CO 2 | Analyze the series for its convergence and divergence to solve real world problems. |
| CO 3 | Evaluate various limit problems using L' Hospital's rule. |
| CO 4 | Identify the ordinary differentials and partial differentials and solve the maximum andminimum value of function. |
| CO 5 | Construct the graphs for function with intervals and identify more application forfunction. |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Calculus | 1, 2, 3, 4, 5 |
| 2 | Sequence and Series – I | 1, 2, 3, 4, 6 |
| 3 | Sequence and Series – II | 1, 2, 3, 4, 6 |
| 4 | Partial Derivatives | 1, 2, 3, 4, 5 |
| 5 | Curve tracing | 1, 2, 3, 4, 5, 6 |

**P P Savani University**
**School of Engineering**

**Department of Science and Humanities**

Course Code: SESH1120
Course Name: Linear Algebra
Prerequisite Course/s: -- Algebra, Geometry, Trigonometry &Pre-Calculus till 12th Standard level

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 3 | 0 | 2 | 5 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- analyse and solve system of linear equations and understand characteristics of Matrices.
- learn about and work with vector space, linear transformation and inner product space.
- apply concepts of linear algebra for solving science and engineering problems.
- introduce the concept of improper integral and Beta-Gamma Function.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Matrix Algebra**<br>Elementary Row and Column operations, Inverse of matrix, Rank of matrix, System of Linear Equations, Characteristic Equation, Eigen values and Eigen vector, Diagonalization, Cayley Hamilton Theorem. | 12 | 30 |
| 2. | **Vector Space**<br>Concept of vector space, Subspace, Linear Combination, Linear Dependence and Independence, Span, Basis and Dimension, Row Space, Column Spaceand Null Space, Rank and Nullity. | 11 | 20 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Linear Transformation**<br>Introduction of Linear Transformation, Kernal and Range, Rank and Nullity, Inverse of Linear Transformation, Rank Nullity Theorem, Composition of Linear Maps. | 9 | 20 |
| 2. | **Inner Product Space**<br>Inner Product, Angle and Orthogonality, Orthogonal projection, Gram-Schmidt process and QR Decomposition, Least square decomposition. | 8 | 20 |

| | | | |
|---|---|---|---|
| 3. | **Beta and Gamma function**<br>Improper Integrals, Convergence, Properties of Beta and Gamma Function, Duplication Formula (without proof) | 5 | 10 |

**List of Tutorial:**

| Sr. No. | Name of Tutorial | Hours |
|---|---|---|
| 1. | Matrix Algebra-1 | 4 |
| 2. | Matrix Algebra-2 | 2 |
| 3. | Vector Space-1 | 4 |
| 4. | Vector Space-2 | 2 |
| 5. | Linear Transformation-1 | 4 |
| 6. | Linear Transformation-2 | 2 |
| 7. | Inner Product Space-1 | 4 |
| 8. | Inner Product Space-2 | 2 |
| 9. | Beta and Gamma function-1 | 4 |
| 10. | Beta and Gamma function-2 | 2 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Thomas' Calculus | George B. Thomas, Maurice D. Weir and Joel Hass | Pearson |
| Elementary Linear Algebra | Howard Anton and Chrish Rorres | Wiley |

**Reference Book(s):**

| Title | Author(s) | Publication |
|---|---|---|
| Advanced Engineering Mathematics | E Kreyszig | John Wiley & Sons |
| A textbook of Engineering Mathematics | N P Bali and Manish Goyal | Laxmi |
| Higher Engineering Mathematics | B S Grewal | Khanna |
| Engineering Mathematics for First Year | T Veerarajan | Tata Mc Graw Hill |
| Engineering Mathematics-1 (Calculus) | H. K. Dass and Dr. Rama Verma | S. Chand |

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

**Tutorial:**

- Continuous evaluation consists of performance of tutorial which will be evaluated out of 10 Marks for each tutorial and average of the same will be converted to 50 marks.
- Continuous Evaluation consists of self-performance assignment to 20 marks.
- Internal Viva consists of 30 marks.

**Course Outcome(s):**

After the completion of the course, the following course outcomes will be able to:

| SESH1120 | LINEAR ALGEBRA & CALCULUS |
|---|---|
| CO 1 | Evaluate linear system using matrices and the knowledge of eigenvalues and eigenvectorsfor matrix diagonalization |
| CO 2 | Determine the basis and dimension of vector spaces and subspaces. |
| CO 3 | Discuss the matrix representation of a linear transformation given bases of the relevantvector space. |
| CO 4 | Apply vectors, inner products, and linear transformations to real world situations. |
| CO 5 | Classify gamma, beta functions & their relation which is helpful to evaluate some definite integral arising in various branch of engineering. |

**Level of Bloom's Revised Bloom's Taxonomy in Assessment**

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Matrix Algebra | 1, 2, 3, 4, 5, 6 |
| 2 | Vector Space | 1, 2, 3, 4, 6 |
| 3 | Linear Transformation | 1, 2, 3, 4, 6 |
| 4 | Inner Product Space | 1, 2, 3, 4, 5, 6 |
| 5 | Beta and Gamma Function | 1, 2, 3, 4, 5 |

**P P Savani University**
**School of Engineering**

**Department of Mechanical Engineering**

Course Code: SEME1110
Course Name: Hardware Workshop

Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 00 | 04 | 00 | 04 | 00 | 00 | 100 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help learners to

- learn about the safety measures required to be taken while using working in workshop.
- learn about how to select the appropriate tools required for specific operation.
- learn about different manufacturing technique for production out of the given raw material.
- understand applications of machine tools, hand tools, power tools and welding process.

**Course Content:**

| ModuleNo. | Contents | Weightagein % |
|---|---|---|
| 1. | **Introduction:**<br>Introduction to Various Shops / Sections and Workshop Layouts,Safety Norms to be Followed in a Workshop.<br>**Fitting Shop:**<br>Introduction of Fitting Shop; Safety; Making a Job as per Drawingincluding Marking and other Performing Operations.<br>**Carpentry and Drilling Shop:**<br>Introduction of Carpentry Shop; Preparation of Job as per Drawingincluding Marking and other Performing Operations.<br>**Introduction to Machine Tools:**<br>Introduction and Demonstration of various Machine Tools like Lathe,Drilling, Grinding, Hack Saw Cutting etc.<br>**Introduction to Welding & Plumbing:**<br>Introduction and Demonstration of Welding process. Introductionand Demonstration of Plumbing Shop. | 25% |
| 2. | **Introduction to Computer Hardware**<br>Computer hardware structure, Identify and understand hardware components: CPU, Motherboard, RAM, HDD, SSD, Keyboard, Ports, Mouse, Monitor, Printer, UPS/SMPS, etc.<br>**Hardware Maintenance and Troubleshooting**<br>Assembling and disassembling a PC, connectors and cables, BIOS setup, Disk management, Device manager, Task manager, Network | 25% |

| | | |
|---|---|---|
| | management, Backup/recovery disk. | |
| 3. | **Electrical and Electronic Skill:** Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C & diode) and ICs on PCB, connections on Breadboard | 25% |
| 4. | **Logic Gates:** Digital Electronics, Symbol and truth table of Logic gates (OR, AND, NOT, NAND, NOR and EX-OR gate), De morgan's theorem.<br>**Cathode Ray Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & Use of CRO forthe measurement of voltage (dc or ac frequency, time period. Special features of dual trace, Digital storage Oscilloscope: Block diagram and principle of working. | 25% |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction and Demonstration of Safety Norms. Different Measuring Instruments. Introduction and Demonstration of Machine Shop. To Perform a Job of Fitting Shop. | 12 |
| 2. | To Perform a Job of Carpentry Shop. Introduction and Demonstration of Plumbing Shop & Welding Process. | 15 |
| 3. | (I)Identify computer hardware layout and components<br>(II)Perform assembling and disassembling of PC | 08 |
| 4. | Configure BIOS, disk, network and other hardware management | 05 |
| 5. | Understanding the electronic components and study of Shouldering and Desoldering of electronic components on PCB Board. | 04 |
| 6. | Understanding the connection on Breadboard and study of Alternate Flashing LED Lightsusing Breadboard. | 06 |
| 7. | Verify the truth table of Logic gates and De morgan's theorem on IC trainer board. | 04 |
| 8. | Study of Cathode Ray Oscilloscope. | 06 |

**Text Book(s):**

| Title | Author(s) | Publication |
|---|---|---|
| Elements of Workshop Technology | S K Hajra Choudhury | Media Promoters & Publishers |
| A text book in Electrical Technology | B L Theraja | S Chand and Co |

**Reference Book(s):**

| Title | Author(s) | Publication |
|---|---|---|
| Basic Electronics: A text lab manual | P.B. Zbar, A.P. Malvino, M.A. Miller | Mc-Graw Hill. |
| Digital Electronics | Subrata Ghoshal | Cengage Learning |

**Course Evaluation:**

**Practical:**

- Continuous Evaluation consists of Performance of Practical/Tutorial which will be evaluated out of 10 for each practical/Tutorial and average of the same will be converted to 30 Marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator
- Internal Viva consists of 30 Marks.
- Practical performance/quiz/drawing/test will consist of 30 Marks.

**Course Outcome(s):**

After the completion of the course, the following course outcomes will be able to:

| **SEME1110** | **HARDWARE WORKSHOP** |
|---|---|
| CO 1 | Apply the application of mechanical workshop such as fitting, drilling and carpentry.Understand various tools of mechanical workshop and understand its applications. |
| CO 2 | Identify and inspect hardware components and interpret latest development of the field. |
| CO 3 | Make students capable of analysing and solving the varieties of problems coming up in the electrical measurements and also enable the students to designas well as trouble shoots the circuits and networks through hands-on mode. |
| CO 4 | Develop skill to build, and troubleshoot digital circuits. |

**Level of Bloom's Revised Bloom's Taxonomy in Assessment**

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Introduction, Fitting Shop, Carpentry Shop and Drilling Shop, Introduction to Machine Tools, Welding and Plumbing | 2,3,4,6 |
| 2 | Introduction to Computer Hardware, Hardware Maintenance and Troubleshooting | 1,2,3,4,5,6 |
| 3 | Understand and designing of Electrical circuit | 2,3,5 |
| 4 | Cathode ray oscilloscope and Digital Electronics | 1,2,3,5 |

**P P Savani University**

**School of Engineering**

**Department of Computer Engineering**

Course Code: SECE1110

Course Name: Software Workshop

Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 00 | 04 | 00 | 02 | 00 | 00 | 100 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help learners to

- Provide a comprehensive knowledge of overall basic computer software tools and technology.
- Providing hands-on experience related to basic software installation, usage of Operating systems, and various essential software utilities.

**Course Content:**

| **Section I** | | |
|---|---|---|
| Module No. | Content | Weightage in % |
| 1. | **Software Fundamentals**<br>Introduction to Software, Types of software, Applications of software, Webbased software, Understand Software specific requirements, Installation of Software | 10 |
| 2. | **Operating System**<br>Introduction of OS, Functions of Operating System, Types of OS, Installation of Windows and Linux OS, Linux architecture, Role of Device Drivers in OS,Shell scripting, Command structure, and general-purpose utility. | 25 |
| 3. | **DOS Commands**<br>Getting Started with DOS, Introduction to Command Prompt, System Files and Command, Creating directories, Traversing through directories, Deleting directories, Viewing Files within a directory. | 15 |
| **Section II** | | |
| Module No. | Content | Weightage in % |
| 1. | **Application Software**<br>Introduction to Application Software, Types of Application Software, Installation of Application Software, Logo Designing, Creating Flowchartsand diagrams, Introduction To Google Apps. | 10 |

| | | |
|---|---|---|
| 2. | **Data Analysis using Application Software**<br>Introduction to Spreadsheets, Spreadsheet Functions to Organize Data, Introduction to Filtering, Pivot Tables, and Charts, VlookUp and HlookUp in Spreadsheets. | 15 |
| 3. | **Website Creation**<br>Creating a website using Google Sites, Creating Web Pages, Working with Images, Working with Documents on Web Pages. Introduction to Wordpress, Installing Web Server and Wordpress, Creating Web pages in Wordpress. | 25 |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1. | Study of Different Software. | 2 |
| 2. | Installation of any 2 software with required plugins and libraries. | 4 |
| 3. | Study of Different Operating Systems. | 2 |
| 4. | Creation of Bootable Pen drive. | 2 |
| 5. | Installation of Windows OS. | 2 |
| 6. | Installation of Linux OS using VMWare. | 2 |
| 7. | Study of Basic commands of Linux/UNIX. | 4 |
| 8. | Study of Basic commands of DOS. | 4 |
| 9. | Design logo using Canva. | 2 |
| 10. | Draw a Flowchart to find maximum of two numbers in either draw.io or Microsoft Visio or LucidChart. | 2 |
| 11. | Study of different Google Apps. | 4 |
| 12. | Create a Google Doc and Google sheet and share with 2 classmates. | 2 |
| 13. | Demonstrate working of HlookUp and VlookUp in Excel. | 2 |
| 14. | Create different types of charts in Excel. | 4 |
| 15. | Demonstrate Data Analysis in Excel. | 4 |
| 16. | Create a Google Website with minimum two pages showing your personaldetails. | 4 |
| 17. | Demonstrate embedding of a youtube video and pdf document on a web pagein google site. | 4 |
| 18. | Demonstrate placing Map and hyperlinks on web page in Google Site. | 4 |
| 19. | Create a wordpress site and create minimum three web pages and menu to navigate between the pages. | 4 |
| 20. | Demonstrate the use of Accordian in wordpress. | 2 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Fundamentals Of Computers, 2nd Edition | Reema Thareja | Oxford University Press |
| Excel 2019 Bible | Michael Alexander, Richard Kusleika, John Walkenbach | Wiley |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| UNIX : Concepts and Applications \| 4th Edition | Sumitabha Das | McGraw Hill Education |

**Web Material Link(s):**

- https://sites.google.com/site/willkimbley/google-apps-tutorials
- https://www.cs.upc.edu/~robert/teaching/foninf/doshelp.html
- https://www.javatpoint.com/software-engineering
- https://www.wikihow.com/Create-a-Website-Using-Google-Sites
- https://www.wpbeginner.com/guides/

**Course Evaluation:**

**Practical:**

- Continuous Evaluation consists of performance of practical, which should be evaluated out of 10 marks per each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during Internal practical Exam.
- Mini Project performance consists of 40 marks during End Semester Exam.

**Course Outcome(s):**

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

| **SECE1110** | **Software Workshop** |
|---|---|
| CO 1 | Understand the types of computer software with their requirements and how to use asper the need. |
| CO 2 | Install different Operating Systems and learn commands used in the OS. |
| CO 3 | Get familiar with the application software and different applications of application software |
| CO4 | Achieve some useful information from data through analysis and represent it with different views like charts, graphs etc. |
| CO 5 | Learn the designing and development of website to have a global communication. |

**Level of Bloom's Revised Bloom's Taxonomy in Assessment**

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Software Fundamentals | 1,2 |
| 2 | Operating System | 1,2,3,6 |
| 3 | Disk Operating System | 2,3 |
| 4 | Application Software | 2,3,4,5 |
| 5 | Data Analysis using Application Software | 3,4,5,6 |
| 6 | Website Creation | 2,3,6 |

**P P Savani University**
**School of Engineering**
**Department of Information Technology**

Course Code: SEIT1110
Course Name: Cyberspace Awareness
Prerequisite Course(s): --

## Teaching & Examination Scheme:

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 2 | 0 | 0 | 2 | 40 | 60 | 00 | 00 | 0 | 0 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

## Objective(s) of the Course:

To help learners to,

- understand governance, regulatory, legal, economic, environmental, social, and ethical context of cyber security.
- equip students with the technical knowledge and skills needed to protect and defined against cyber threats.
- help students to protect the one's data, systems, and networks from malicious attacks and cyber threats.

## Course Content:

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Cyber space**<br>Cyber space, Cyber Crime and its Types, Overview of Cyber Security, Cyber Attacks in History, Internet Governance, Hacking and its Types, Cracking, Overview of System and Web Vulnerability, OWASP | 06 | 20 |
| 2. | **Cyber Threats**<br>Various Cyber Threats, Malware, Phishing, Password Attacks, DOSattack, Man in the Middle, Drive by download, Malvertising, Rogue Software, Cyber Warfare and its conflicts, Cyber Terrorism, Case studies | 09 | 30 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Cyber security Practices**<br>Cyber Security Practices and dos and don'ts, Data Privacy and Security, Security Controls, Overview of social media and its security, E- Commerce, Digital payments and its security, Tools and technology for cyber security, Platform to report and combat cyber crime, Case studies | 05 | 15 |

| | | | |
|---|---|---|---|
| 2. | **Cyberspace and the Law**<br>Cyber Security Regulations, Cyber Law, need for a ComprehensiveCyber Security Policy, Need for an International convention on Cyber space, Contemporary crime, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards, The INDIAN Cyberspace, Indian IT Act 2000, Indian IT Act 2008, Case studies | 06 | 15 |
| 3. | **Cyber Forensics**<br>Introduction to Cyber Forensics, Handling Preliminary analysis, Investigating Investigations, Controlling an Investigation, Legal Policies,Case studies | 04 | 20 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Cybersecurity for Beginners | Raef Meeuwisse | Cyber Simplicity Ltd |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Cyber Security | Nina Godbole, Sunit Belapure | Wiley India, New Delhi |
| The Indian Cyber Law | Suresh T. Vishwanathan; | Bharat Law House New Delhi |

## Course Evaluation:

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

## Course Outcome(s):

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

| SEIT1110 | Cyberspace Awareness |
|---|---|
| CO 1 | Understand Concepts of Cyber space. |
| CO 2 | Analyze the Concepts of Cyber Threats. |
| CO 3 | Elaborate the overview of social media and understanding cybercrimes. |
| CO 4 | Identify cyber laws and cyber acts in India. |
| CO 5 | Explore different case studies based on cyber-Forensics. |

Level of Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction to Cyber space | 1 |
| 2 | Cyber Threats | 1,2 |
| 3 | Cyber security Practices | 1,2,3 |
| 4 | Cyberspace and the Law | 1,2 |
| 5 | Cyber Forensics | 1,23 |

**P P Savani University**

**School of Engineering**

**Department of Computer Engineering**

Course Code: SEIT1120

Course Name: Competitive Quantitative Aptitude

Prerequisite Course(s): ---

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | 00 | 00 | 02 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

- This course is designed to suit the need of the outgoing students and to acquaint them with frequently asked patterns in quantitative aptitude and logical reasoning during various examinations and campus interviews.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightagein % |
| 1. | **Quantitative Ability (Basic Mathematics)**<br>Number Systems, LCM and HCF, Decimal Fractions, Simplification, Square Roots and Cube Roots, Average, Problems on Ages, Surds & Indices, Percentages, Problems on Numbers, Quadratic Equations | 5 | 15 |
| 2. | **Quantitative Ability (Applied & Engineering Mathematics)- Part I**<br>Logarithm, Permutation and Combinations, Probability, Profit and Loss, Simple and Compound Interest, | 5 | 35 |
| 3. | **Quantitative Ability (Applied & Engineering Mathematics)**<br>**-Part II**<br>Time, Speed and Distance, Time & Work, Ratio and Proportion, Mixturesand Allegation | 5 | 20 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightagein % |
| 1. | **Data Interpretation**<br>Data Interpretation, Tables, Column Graphs, Bar Graphs, Line Charts, PieChart, Venn Diagrams1 | 6 | 20 |

| | | | |
|---|---|---|---|
| 2. | **Logical Reasoning (Deductive Reasoning)**<br>Analogy, Blood Relation, Directional Sense, Number and Letter Series, Coding – Decoding, Calendars, Clocks, Seating Arrangement, Syllogism | 6 | 20 |
| 3. | **Mensuration & Trigonometry**<br>Two-dimensional (2D) and Three-dimensional (3D) Mensuration,Degree and Radian Measures, Trigonometric Ratios, Complementary Angles, Height and Distance, Standard Identities, Area, Inequalities | 3 | 10 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Quantitative aptitude for Competitive examination | R S Agarwal | S. Chand |
| A Modern Approach to Verbal & Non-Verbal Reasoning | R S Agarwal | S. Chand |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Analytical and Logical reasoning | Sijwali B S | arihant |

**Web Material Link(s):**

- https://prepinsta.com/
- https://www.indiabix.com/
- https://www.javatpoint.com/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

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

| SEIT1120 | Competitive Quantitative Aptitude |
|---|---|
| CO 1 | Understand the basic concepts of quantitative ability |
| CO 2 | Understand the basic concepts of logical reasoning Skills |
| CO 3 | Acquire satisfactory competency in use of reasoning |
| CO4 | Solve campus placements aptitude papers covering Quantitative Ability, Logical ReasoningAbility |
| CO 5 | Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Quantitative Ability (Basic Mathematics) | 1, 3, 5 |
| 2 | Quantitative Ability (Applied & Engineering Mathematics) | 1, 2, 3, 5 |
| 3 | Data Interpretation | 2, 3, 6 |
| 4 | Logical Reasoning (Deductive Reasoning) | 2, 4, 5 |
| 5 | Mensuration & Trigonometry | 1, 3, 5 |

**P P Savani University**
**School of Engineering**
**Department of Computer Engineering**

Course Code: SECE1120
Course Name: Joy of Programming
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | 00 | 04 | 40 | 60 | 40 | 60 | 00 | 00 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to
- identify appropriate approach to computational problems.
- develop logic building and problem-solving skills.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightagein % |
| 1. | **Motivation of Programming:** Use of Programming, Importance of Programming, Discussion of different Case Study | 5 | 14 |
| 2. | **Welcome to Programming:** Introduction of Programming, Flow Charts and Algorithms,Debugging, Tracing the execution of the Program, Watching Variables Values in Memory, Character Set, Keyword and Identifiers, Constants and Variables, Data Types - Declaration and Initialization, Basic Input, and Output Operations, Symbolic Constants, Overflow and Underflow of Data. | 9 | 18 |
| 3. | **Conditional Statements and Looping Statements:** Decision Making & Branching: Decision Making with If and If - else Statements, Nesting of If-else Statements, The Switch and go-to statements. Looping: The while Statement, The Break Statement &The Do While loop, The FOR loop, Jump within loops - Programs. | 9 | 18 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightagein % |
| 1. | **Collection of Data:** Introduction, One-dimensional Arrays, Two-dimensional Arrays, Concept of Multidimensional Arrays, Declaring andInitializing String Variables, Arithmetic Operations on Characters,Putting Strings Together, Comparison of Two Strings, String Handling Functions, Dictionary, List, Tuples and Sets. | 10 | 20 |
| 2. | **Functions** Introduction to Functions, defining a Function, Calling a Function, Types of Functions, Function Arguments, Anonymous Functions, | 6 | 15 |

| | | | |
|---|---|---|---|
| | Global and Local Variables, Recursion | | |
| 3. | **Building Desktop Application**<br>Exploring the Tkinter Library in Python, Creating basic Desktop application using Tkinter | 6 | 15 |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1. | Working with basic elements of C languages (different input functions, different output functions, different data types, and different operators). | 2 |
| 2. | Working with control structures (if statement, if-else statement, nested if-else statement, switch statement, break statement, goto statement). | 2 |
| 3. | Working with array and strings in C. | 4 |
| 4. | Introduction to Python (Introduction to IDLE, different data types, Input Output in Python, Operators, Operator precedence). | 2 |
| 5. | Implementation of Dictionaries, Sets, Tuples and Lists and its various methods inPython. | 6 |
| 6. | Working with functions in C/Python. | 2 |
| 7. | Working with recursive function in C/Python. | 2 |
| 8. | Building desktop application of your own calculator in Python. | 4 |
| 9. | Case Study:<br>a. Sorting : Arrange the books<br>b. Searching : Find in seconds<br>c. Recursion : Tower of Hanoi | 6 |

***# Use of different libraries will be covered in Practical Assignments.***

**Text Book(s):**

| Title | Author(s) | Publication |
|---|---|---|
| Programming in ANSI C | E. Balagurusamy | Tata McGraw Hill |
| Python Programming: A modular approach | Sheetal Taneja, Naveen Kumar | Pearson |

**Reference Book(s):**

| Title | Author(s) | Publication |
|---|---|---|
| Programming in C | Ashok Kamthane | Pearson |
| Python Cookbook | David Ascher, Alex Martelli Oreilly | O Reilly Media |

**Web Material Link(s):**

- https://www.tutorialspoint.com/cprogramming/index.htm
- https://www.w3schools.com/c/
- https://www.tutorialspoint.com/python/
- https://www.w3schools.com/python/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva/oral performance consists of 30 marks during End Semester Exam.

**Course Outcomes:**

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

| **SECE1120** | **JOY OF PROGRAMMING** |
|---|---|
| CO 1 | Immediately analyze the syntax and semantics of the computer languages and apply it in programs. |
| CO 2 | Implement computing solutions using logic building and problem-solving skills of a given programming language. |
| CO 3 | Interpret the fundamental language syntax, semantics and fluent in the use of python orany computer language control flow statements. |
| CO 4 | Determine the methods to create and manipulate programs by utilizing the datastructures like lists, dictionaries, tuples and sets with emphasis on Python. |

**Level of Revised Bloom's Taxonomy in Assessment:**

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1. | Motivation of Programming | 1, 2, 4 |
| 2. | Welcome to Programming | 1, 2, 3 |
| 3. | Conditional Statements and Looping Statements | 1, 2, 3 |
| 4. | Collection of Data | 1, 2, 3 |
| 5. | Functions | 2, 3, 4, 6 |
| 6. | Building Desktop Application | 2, 3, 4, 6 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH1110
Course Name: Fundamental Chemistry & Environmental Science
Prerequisite Course(s): -

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | 00 | 04 | 40 | 60 | 40 | 60 | 00 | 00 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- Understand the basic concepts of chemistry, including atoms, molecules, and chemical processes.
- Apply the scientific method to examine chemical phenomena, including the design and execution of experiments, data analysis, and evidence-based conclusion drawing.
- Evaluate the causes and consequences of environmental problems and propose solutions based on scientific evidence.
- Integrate knowledge from multiple disciplines to analyze environmental problems and propose effective solutions.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Chemistry**<br>Overview of the scientific method and chemistry as a science, Basic concepts of matter, including atoms, molecules, and the periodic table, Introduction to chemical bonding and intermolecular forces, Basic principles of chemical reactions, including stoichiometry and reaction types | 6 | 15 |
| 2. | **Chemical Thermodynamics and Kinetics**<br>Introduction to thermodynamics and the laws of thermodynamics, Energy and enthalpy changes in chemical reactions, Introduction to chemical kinetics and reaction rates, Factors affecting reaction rates, including temperature, concentration, and catalysts | 6 | 15 |
| 3. | **Properties of Matter and Solutions**<br>Physical properties of matter, including states of matter and phase changes, Solutions and their properties, including solubility and colligative properties, Introduction to acids and bases and their properties, Chemical equilibrium and the equilibrium constant | 5 | 10 |
| 4. | **Organic Chemistry**<br>Introduction to organic chemistry and the basics of carbon chemistry, | 6 | 10 |

| | | | |
|---|---|---|---|
| | Functional groups and their properties, Nomenclature and isomerismin organic compounds, Introduction to organic reactions and Mechanisms | | |

| **Section II** | | | |
|---|---|---|---|
| Module | Content | Hours | Weightage in % |
| 1. | **Introduction to Environment**<br>Definition, principles and scope of Environmental Science, Impacts of development on Environment, Environmental Degradation, The interdisciplinary nature of environmental science, Concept of 4R's | 06 | 10 |
| 2. | **Environmental Pollution**<br>a) Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants.<br>b) Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources ofcommon air pollutants like PM, $SO_2$, $NO_X$, Auto exhaust, Effects of common air pollutants<br>c) Noise Pollution: Introduction, Sound and Noise, Noise measurements, Causes and Effects.<br>d) Solid Waste: Generation and management<br>e) Bio-medical Waste: Generation and management<br>f) E-waste: Generation and management | 08 | 20 |
| 3. | **Social Issues and Environment**<br>Sustainable Development, Equitable use of Resources for sustainable lifestyle and it's benefits, Water conservation, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Carbon Footprint | 08 | 20 |

**List of Practical:**

| **Sr. No** | **Name of Practical** | **Hours** |
|---|---|---|
| 1. | Acid-base titration adding a base of known concentration to an acid of unknown concentration until the reaction is complete, and the concentration of the acid is determined. | 02 |
| 2. | Determination of the boiling point of a liquid heating a sample of a liquid and observing the temperature at which it boils. | 02 |
| 3. | Determination of the density of a liquid weighing a known volume of a liquid and calculating its density. | 04 |
| 4. | Determination of the pH of a solution using a pH meter to measure the acidity or basicity of a solution. | 04 |
| 5. | Flame test: burning a sample of a substance and observing the color of the flame to identify the presence of certain elements. | 04 |
| 6. | Preparation of a salt reacting an acid and a base to form a salt and observing the reaction products. | 02 |
| 7. | Testing of soil acidity | 02 |

| | | |
|---|---|---|
| 8. | Studying the effect of temperature on the solubility of a solid in water at different temperatures to see how temperature affects solubility. | 02 |
| 9. | Studying the properties of acids and bases: Students can test the properties of different acids and bases (e.g., pH, conductivity) and compare their properties. | 04 |
| 10. | Investigating the reaction between an acid and a metal and measure the amount of gas produced. | 04 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Textbook of Environmental Chemistry and Pollution Control | Dr. S. S. Dara, Dr. D.D. Mishra | S Chand & Co Ltd |
| Environmental Studies | Benny Joseph | Mc.Graw hill education Pvt. Ltd. |
| Environmental Studies | Dr. S.K. Dhameja | S.K. Kataria & Sons |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Engineering Chemistry | Jain & Jain | Dhanpat Rai Publishing company |
| Environmental Studies (From crisis to cure) | R. Rajagopalan | OXFORD university press |

**Web Material Link(s):**

https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_ENS_LECTURE_NOTES_2.pdf

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal Viva consists of 20 marks.
- Practical performance/quiz/drawing/test of 30 marks during End Semester Exam.
- Viva/Oral presentation consists of 30 marks during End Semester Exam.

**Course Outcome(s):**

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

| SECH1110 | Fundamental Chemistry & Environmental Science |
|---|---|
| CO 1 | Develop a fundamental understanding of the principles and concepts of chemistry, including atomic structure, chemical reactions, and chemical bonding. |
| CO 2 | Demonstrate an ability to apply chemical knowledge to real-world problems, such as calculating reaction yields and predicting chemical properties. |
| CO 3 | Identify the types of pollution in society along with their sources. |
| CO 4 | Realize the global environmental issues. |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Introduction to Chemistry | 2,1 |
| 2 | Chemical Thermodynamics and Kinetics | 4, 5 |
| 3 | Properties of Matter and Solutions | 1,2 |
| 4 | Organic Chemistry | 4,5 |
| 5 | Introduction to Environment | 1,2 |
| 6 | Environmental Pollution | 1,2,3 |
| 7 | Social Issues and Environment | 1,2,3 |

**P P Savani University**
**School of Engineering**

## Department of Mechanical Engineering

Course Code: SEME1120
Course Name: Fundamentals of Technical Drawing

Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 00 | 04 | 00 | 04 | 00 | 00 | 40 | 60 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help learners to

- Know conventions and the methods of engineering drawing.
- Interpret engineering drawings using fundamental technical mathematics.
- Construct basic and intermediate geometry.
- Improve their visualization skills so that they can apply these skills in developing new products.
- Improve their technical communication skill in the form of communicative drawings.
- Comprehend the theory of projection.
- Basic knowledge of computer-aided drawing using AutoCAD.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| ModuleNo. | Contents | Lab Hours | Weightagein % |
| 1. | **Introduction:** Importance of the Course; Use of Drawing Instruments andaccessories; BIS – SP – 46; Lettering, Dimensioning, and Lines; Representative Fraction; Types of Scales (Plain and Diagonal Scales); Construction of Polygons. | 03 | 05% |
| 2. | **Engineering Curves:** Classification and Application of Engineering Curves; Construction of Conics, Cycloidal Curves, Involutes, Spiral, and Normal & Tangent to each curve. | 12 | 15% |
| 3. | **Projections of points, lines & planes:** Types of Projections; Introduction of Principle Planes of Projections; Projection of Points in all four Quadrants; Projection of Lines inclined to one Referral Plane & two Referral Planes. True length and inclination with reference plane; Projection of Planes (Circular and Polygonal) with inclination to one Referral Plane and two Referral Planes; Concept of Auxiliary Projection Method. | 15 | 30% |

| Section II | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightagein % |
| 1. | **Orthographic Projection and Isometric Projections**<br>Types of Projections: Principle of First and Third Angle Projection Applications & Difference; Projection from Pictorial view of Object, View from Front, Top, and Sides; Full Section View. Isometric Scale, Conversion of Orthographic views into Isometric Projection, Isometric View, or Drawing of simple objects. | 18 | 30% |
| 2. | **Residential Building Planning:**<br>Introduction to buildings, Classification of buildings, Principles of building planning, Principles of architecture composition, Detail drawing, Line Plan, plan, elevation, section, Preparing working drawing of residential building. | 06 | 10% |
| 3. | **Computer-Aided Drawing:**<br>Introduction to AutoCAD, Basic commands for 2D drawing (Line, Circle, Polyline, Rectangle, Hatch, Fillet, Chamfer, Trim, Extend, Offset, Dimstyle, etc.) | 06 | 10% |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction sheet (dimensioning methods, different types of lines,construction ofvarious polygons, dividing the line and angle into parts, use of stencil, lettering), plane scale and diagonal scale | 03 |
| 2. | Engineering curves | 12 |
| 3. | Projection of points, lines & planes | 15 |
| 4. | Orthographic projection | 10 |
| 5. | Isometric projection | 10 |
| 6. | Residential building drawing (Line plan, Plan, Elevation, Section, Schedule opening) | 04 |
| 7. | Computer-Aided Drawing | 06 |

**Text Book(s):**

| Title | Author(s) | Publication |
|---|---|---|
| A Text Book of Engineering Graphics | P J Shah | S. Chand & Company Ltd., New Delhi |
| Engineering Drawing | N D Bhatt | Charotar Publishing House, Anand |
| Building Planning, Designing and Scheduling | Gurucharan Singh | Standard Book |

**Reference Book(s):**

| Title | Author(s) | Publication |
|---|---|---|
| Engineering Drawing | P.S.Gill | S. K. Kataria & sons, Delhi |
| Engineering Drawing | B. Agrawal & C M Agrawal | Tata McGraw Hill, New Delhi |
| Engineering drawing made Easy | K. Venugopal | Wiley Eastern Ltd |
| Building Drawing | M. G. Shah, C.M. Kale, S.Y. Patki | Tata McGraw Hill |

**Web Material Link(s):**

- http://nptel.ac.in/courses/105104148/

**Course Evaluation:**

**Practical:**

- Continuous evaluation consists of performance of practical/tutorial which will be evaluated out of 20 marks for each practical/tutorial and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical test will consist of 30 marks and viva will consist of 30 marks during end semester exam.

**Course Outcome(s):**

After the completion of the course, the following course outcomes will be able to:

| SEME1120 | FUNDAMENTALS OF TECHNICAL DRAWING |
|---|---|
| CO 1 | Apply BIS standards of building planning and conventions while drawing Lines,printing Letters, and showing dimensions. |
| CO 2 | Explore the various methods to draw various engineering curves and their applications. |
| CO 3 | Classify the orthographic projection systems concerning the observer, object, andreference planes. |
| CO 4 | Develop 3D Isometric views in relation to 2D orthographic views. |
| CO 5 | Software application in engineering drawing. |

**Level of Bloom's Revised Bloom's Taxonomy in Assessment**

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction | 1, 2, 6 |
| 2 | Engineering Curves | 2, 6 |
| 3 | Projection of Points, Line & Plane | 1, 2, 3, 4 |
| 4 | Orthographic Projection | 2, 5, 4 |
| 5 | Isometric Projections and Isometric Drawing | 2, 5, 4 |
| 6 | Computer-Aided Drawing | 2,3,6 |

**P P Savani University**

**School of Engineering**

**Department of Civil Engineering**

Course Code: SECV1110

Course Name: Core Engineering Concepts.

Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | 00 | 04 | 40 | 60 | 40 | 60 | 00 | 00 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help learners to

- Study the basic fundamentals of construction planning and material.
- Study significance of mechanical engineering systems in different fields of engineering.
- Study the basic concepts of electrical and electronics engineering.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Basics of Construction material and techniques**<br>Common materials used in construction, Aggregate, Sand, Cement,Bricks, Timber, Steel, Paints. Bonds in brick masonry techniques, Foam works, Curing, Compaction of concrete, Water proofing, Fire safety norms and requirement. | 08 | 18 |
| 2. | **Building planning and Bye laws**<br>Building by laws as per national building code, building by laws asper local authority, standards for residential, public, commercial, industrial and institutional buildings planning, planning of earth quake resistance building, overview of RERA and ODPS, Green building and LEED certification, general layout, maps and plan used at construction site. | 08 | 18 |
| 3. | **Basic Electricity Principles**<br>Concept of Charge, Potential Difference and Current, Resistor, capacitor, Inductor, Ohm's law, effect of Temperature on resistance, temperature coefficient, Series and parallel combinations of Resistors and capacitors, Lenz and Faraday's laws for electromagnetic induction, AC Electricity and DC Electricity.<br>**Electrical Wiring:** Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. | 07 | 14 |

| Section II | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Basics of I.C Engines:**<br>Construction and working of 2 Stroke & 4 Stroke Petrol and Diesel Engines, Difference Between 2-Stroke - 4 Stroke Engine & Petrol-Diesel Engine, Efficiency of I. C. Engines. | 08 | 18 |
| 2. | **Power Transmission Elements:**<br>Construction and Applications of Couplings, Clutches and<br>Brakes, Difference Between Clutch and Coupling, Types of BeltDrive and Gear Drive | 08 | 18 |
| 3. | **DC Circuits and AC Circuits**<br>DC Circuits:<br>Introduction of Electrical circuit elements (prerequisites), voltage and current sources, Kirchoff's current and voltage laws, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.<br>AC Circuits:<br>Representation of sinusoidal waveforms, peak and RMS values, Phasor representation of AC quantities, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), Series and parallel resonance. Three phase balanced circuits, voltage and current relations in star and delta connections, Power<br>measurement in three phase circuits. | 06 | 14 |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1. | Preparation of drawing sheet showing various bonds. | 04 |
| 2. | Preparation of Basic plan of Construction site. | 04 |
| 3. | Preparation sketch of various building component. | 04 |
| 4. | Verify the series and parallel connections of resistors and capacitors. | 04 |
| 5. | To understand construction and working of various types of boilers. | 04 |
| 6. | To understand construction and working of mountings and accessories. | 04 |
| 7. | To verify the Kirchoff's current and voltage laws and Network theorems. | 02 |
| 8. | To understand construction and working 2 –stroke & 4 –stroke Petrol engines. | 02 |
| 9. | To understand construction and working 2 –stroke & 4 –stroke Diesel engines. | 02 |

**Text Book(s):**

| Title | Author(s) | Publication |
|---|---|---|
| Elements of Mechanical Engineering | Sadhu Singh | S. Chand Publications |
| Building construction | Dr. B C Punamia | Laxmi Publication |

| | | |
|---|---|---|
| A text book in Electrical Technology | B L Theraja - | S Chand & Co. |
| Basic Electrical Engineering | D. C. Kulshreshtha | McGraw Hill, 2009 |

**Reference Book(s):**

| Title | Author(s) | Publication |
|---|---|---|
| Basic Mechanical Engineering | T.S. Rajan | Wiley Eastern Ltd., 1996. |
| Town Planning | G. K. Hiraskar | Dhanpatrai Publications |
| Basic Electrical Engineering | Nagsarkar and Sukhija, | Oxford University Press |

**Web Material Link(s):**

- http://nptel.ac.in/course.php

**Course Evaluation:**

**Theory:**

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of practical which will be evaluated out of 20 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test of 30 marks during End Semester Exam.
- Viva/Oral performance of 30 marks during End Semester Exam.

**Course Outcome(s):**

After the completion of the course, the following course outcomes will be able to:

| | |
|---|---|
| SECV1110 | Core Engineering Concepts |
| CO 1 | Understand basic properties of various construction materials. |
| CO 2 | Understand the general rules and regulation of building planning. |
| CO3 | Apply the principles of basic mechanical engineering. |
| C04 | Comprehend the importance of mechanical engineering equipments like IC engine and power transmission elements. |
| CO5 | Understand working of various instruments and equipments used for the measurement of various electrical engineering parameters like voltage, current, power, phase etc in industry as well as in power generation, transmission and distribution sectors. |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Basics of Construction material and techniques | 1, 2, 3 |
| 2 | Building planning and Bye laws | 1, 2 |
| 3 | Basic Electricity Principles | 1,2,3 |
| 4 | Power Transmission Elements | 1, 2 |
| 5 | Basics of I.C Engines | 2 |
| 6 | DC Circuits and AC Circuits | 2,3,4 |
| 7 | Basics of Steam Generators | 1, 2 |

**P P Savani University**

**School of Engineering**

Course Code: CLSC2180

Course Name: Essentials of Entrepreneurship

Prerequisite Course(s):

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | 00 | 00 | 2 | 100 | 00 | 00 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help learners to

- To understand the basics of entrepreneurship and its traits
- To analyze the theory and models of entrepreneurships
- To evaluate different types and dimensions of entrepreneurship

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Entrepreneurship**<br>Definition of Entrepreneurship, Entrepreneurship as a career choice, Benefits and Myths of Entrepreneurship, Characteristics, Qualities and Skills of an Entrepreneur, Model Traits of Entrepreneurs | 07 | 30 |
| 2. | **Dimensions of Entrepreneurship**<br>Entrepreneurship Theories, Intrapreneurship, Benefits of intrapreneurship, Difference between Entrepreneurs and Intrapreneurs Institutes for Entrepreneurship Development, sStartup Failures, StartupSuccess Stories | 08 | 20 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Women Entrepreneurship**<br>Women Entrepreneurship Meaning, Factors that influence women Entrepreneurship, Barriers to Women Entrepreneurship, Qualities of Women Entrepreneurs, Success stories of Women Entrepreneurs<br>Lijjat Papad Case study, Jassuben Pizza Case study | 08 | 30 |
| 2. | **Social Entrepreneurship and emerging trends**<br>Social Entrepreneurship, Functions of Social Entrepreneurship, Difference between Entrepreneurship and Social EntrepreneurshipHow does an NGO run?, Case Study on Social Entrepreneurship, Emerging trends in Entrepreneurship | 07 | 20 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Entrepreneurship Business and Management | Dr. R C Bhatia | Sultan Chand and Sons |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Entrepreneurship | Trehan A | Dremtech |

**Web Material Link(s):**

- https://www.startupindia.gov.in
- https://ediindia.ac.in
- https://www.ediindia.org

**Theory:**

- Continuous Evaluation consists of one test of 20 marks, 10 marks assignment, 10 marks presentation, 10 marks class participation and behavior.
- One live project of 50 marks

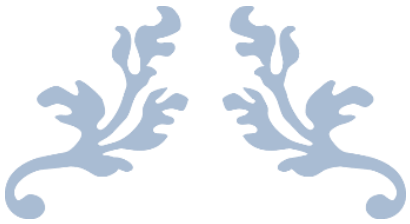
**Course Outcome(s):**

| CLSC2070 | Essentials of Entrepreneurship |
|---|---|
| CO 1 | Students will be able to think of startup ideas |
| CO 2 | Students will be able to apply the model of entrepreneurship practically |
| CO 3 | Students will be able to further analyze other dimensions of Entrepreneurship |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction to Entrepreneurship | 1, 2, 3, 4, 5 |
| 2 | Dimensions of Entrepreneurship | 1, 2, 3, 4, 5 |
| 3 | Women Entrepreneurship | 1, 2, 3, 4, 6 |
| 4 | Emerging Trends and Social Entrepreneurship | 1, 2, 3, 4, 6 |



# SECOND YEAR B.TECH

**P P SAVANI UNIVERSITY**

**SCHOOL OF ENGINEERING**

**TEACHING & EXAMINATION SCHEME FOR SECOND YEAR B.TECH. PROGRAMME AY: 2023-24**

| Sem | Course Code | Course Title | Offered By | Teaching Scheme | | | | | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Contact Hours | | | | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | Theory | Practical | Tutorial | Total | | CE | ESE | CE | ESE | CE | ESE | |
| 3 | SESH2110 | Differential Methods & Complex Variable | SH | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SECH2210 | Chemical Process Calculations | CH | 2 | 0 | 2 | 4 | 4 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SECH2220 | Mechanical Operations | CH | 2 | 2 | 0 | 4 | 3 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH2230 | Fluid Flow Operations | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH2240 | Materials Science and Technology | CH | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | CFLS2140 | Upper Intermediate Communicative English | CFLS | 2 | 0 | 0 | 2 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | CLSC2020 | IPDC-I | CLSC | 2 | 0 | 0 | 2 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | | | | | **Total** | **24** | **22** | | | | | | | **1100** |
| 4 | SESH2120 | Numerical Methods & Statistics | SH | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SECH2250 | Heat Transfer Operations | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH2260 | General Chemical Technology | CH | 2 | 2 | 0 | 4 | 3 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH2270 | Chemical Engineering Thermodynamics-I | CH | 2 | 0 | 2 | 4 | 4 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SECH2280 | Mass Transfer Operations-I | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | CLSC2030 | IPDC-II | CLSC | 2 | 0 | 0 | 2 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | | | | | **Total** | **25** | **22** | | | | | | | **1100** |

**P P Savani University**
**School of Engineering**

## Department of Science & Humanities

Course Code: SESH2110
Course Name: Differential Methods & Complex Variable
Prerequisite Course(s): SESH1110- Calculus

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | - | 02 | 05 | 40 | 60 | - | - | 100 | - | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learner to

- learn orientation of calculus and its applications in solving engineering problems including differential equations.
- learn introduction of Partial Differential Equations with methods of its solutions.
- learn applications of Laplace Transforms for solving ODEs.
- learn introduction of Periodic functions and Fourier series with their applications for solving ODEs.
- Represent complex numbers algebraically and geometrically.

**Course Content:**

| Section I | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | Ordinary Differential Equation<br>First order ODEs, Formation of differential equations, Exact, linear and Bernoulli's equations, Ordinary differential equations of higher orders, Homogeneous Linear ODEs of Higher Order, Homogeneous Linear ODEswith Constant Coefficients, Euler–Cauchy Equations Differential Operators Nonhomogeneous ODEs, Variation of Parameters. | 10 | 20 |
| 2. | Partial Differential Equation<br>Formation of First and Second order equations, Solution of First order Linear and Non-liner equations, Higher order equations with constant coefficients, Complementary function, Particular Integrals, Initial and boundary conditions, Modeling and solution of the Heat, Wave and Laplace equations. | 08 | 17 |
| 3. | Laplace Transform<br>Laplace Transform, Linearity, First Shifting Theorem, Existence Theorem, Transforms of Derivatives and Integrals, Unit Step Function, Second Shifting Theorem, Laplace Transformation of Periodic function, Inverse Laplace transform, Convolution, Systems of ODEs. | 07 | 13 |
| Section II | | | |

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | Fourier Series<br>Fourier Series of $2n$ periodic functions, Euler Formula, Arbitrary Period,Even and Odd function, Half-Range Expansions. | 07 | 14 |
| 2. | Complex Variables<br>Complex Variable – Differentiation, Complex number, polar form ofcomplex number, Cauchy-Riemann equations, analytic functions, harmonic functions, Mobius transformations and their properties. | 08 | 21 |
| 3. | Complex Variable - Integration<br>Representation by Fourier Integral, Cauchy's integral theorem and formula, Taylor and Laurent series. | 05 | 15 |

**List of Tutorials:**

| Sr. No. | Name of Tutorial | Hours |
|---|---|---|
| 1. | Ordinary Differential Equation-1 | 2 |
| 2. | Ordinary Differential Equation-2 | 2 |
| 3. | Ordinary Differential Equation-3 | 2 |
| 4. | Partial Differential Equation-1 | 2 |
| 5. | Partial Differential Equation-2 | 4 |
| 6. | Laplace Transform-1 | 4 |
| 7. | Laplace Transform-2 | 2 |
| 8. | Fourier Series-1 | 2 |
| 9. | Fourier Series-2 | 2 |
| 10. | Complex Variables -1 | 2 |
| 11. | Complex Variables -2 | 2 |
| 12. | Complex Variables -3 | 4 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Advanced Engineering Mathematics | Erwin Kreyszig | Wiley India Pvt. Ltd. |
| Complex Variables and Applications, | J. W. Brown and R. V. Churchill | McGraw Hill. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Higher Engineering Mathematics | B. S. Grewal | Khanna Publishers |
| A first course in complex analysis with applications | Dennis G. Zill, Patrick D. Shanahan | Jones and Bartlett Publishers Inc. |
| Differential Equations for Dummies | Steven Holzner | Wiley India Pvt. Ltd. |
| Higher Engineering Mathematics | H.K. Dass, Er. Rajnish Verma | S. Chand & Company Pvt. Ltd. |

**Web Material Link(s):**

- http://nptel.ac.in/courses/111105035/
- http://nptel.ac.in/courses/111106100/
- http://nptel.ac.in/courses/111105093/
- http://nptel.ac.in/courses/111108081/
- http://nptel.ac.in/courses/111/103/111103070/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Tutorial:**

- Continuous Evaluation consists of performance of tutorial which will be evaluated out of 10 marks for each tutorial and average of the same will be converted to 30 marks.
- MCQ based examination consists of 10 marks.
- Internal Viva consists of 10 marks.

**Course Outcome(s):**

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

| **SESH2110** | **DIFFERENTIAL METHODS & COMPLEX VARIABLE** |
|---|---|
| CO1 | Describe 1st and 2nd order odes and pde's. |
| CO2 | Classify differential equations and evaluate linear and nonlinear partial differentialequations. |
| CO3 | Apply Laplace transform as a tool which are used to evaluate differential equation. |
| CO4 | Examine the various tests of power series and Fourier series for learning engineering. |
| CO5 | Demonstrate understanding of the basic concepts underlying complex analysis to evaluatedefinite integrals and infinite series. |

**Mapping of CO with PO**

| **SESH2110** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 1 | 1 | | | | | | | | 1 |
| CO 2 | 1 | 1 | 1 | | | | | | | | | 1 |
| CO 3 | 2 | 1 | 1 | 1 | | | | | | | | 1 |
| CO 4 | 2 | 1 | 1 | | | | | | | | | 1 |
| CO 5 | 2 | 2 | 1 | 1 | | | | | | | | 1 |

**Mapping of CO with PSO**

| **SECV2110** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 2 | 1 | |
| CO 2 | 1 | 1 | |
| CO 3 | 1 | 1 | |
| CO 4 | 2 | | |
| CO 5 | 2 | 1 | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Ordinary Differential Equation | 1, 2, 3, 5 |
| 2 | Partial Differential Equation | 1, 2, 4, 5 |

| | | |
|---|---|---|
| 3 | Laplace Transform | 1, 2, 4, 5 |
| 4 | Fourier Series | 1, 2, 3, 5 |
| 5 | Complex Variables | 1, 2, 3, 4, 5 |
| 6 | Complex Integration | 1, 2, 3, 4, 5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH2210
Course Name: Chemical Process Calculations
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | 02 | 04 | 40 | 60 | -- | -- | 100 | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learner to

- know the conventions and the methods of chemical process.
- develop the basic acumen for the Chemical Engineering and its calculations.
- know how to carry out various process calculations.
- improve their analytical skills for various chemical processes.
- improve their technical ability in the form of numerical analysis of chemical problems.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Introduction:** Chemical Engineering and Chemical Industry, Steady state andunsteady state processes, Unit Operations, Unit Processes and Process Flow Diagrams. | 02 | 03 |
| 2. | **Graphics and Basics of Chemical Processes:** Graphical methods of curve fittings, Method of least squares, Solution of cubic equations by trial and error method, Conversion ofunits, Dimensional analysis, Properties of gas, liquid and solid, Equations of state. | 03 | 07 |
| 3. | **Basic Calculations:** State properties: Molecular weight, Compositions, Density, Vapor pressure etc for gas, liquid and solid systems, Thermal properties: Heat capacity, Sensible heat, Latent heat, Heat of reaction, Heat of solution, Enthalpy calculations etc. for gas, liquid and solid systems,Techniques of problem Solution: Analytical, Graphical and Numerical, Gas laws and phase equilibria, Humidity, Saturation and Crystallization. | 05 | 20 |
| 4. | **Material Balances:** Materials balance: Concepts of limiting and excess reactants, Batch,Stage-wise, Continuous and recycle operations, Material balance of systems involving mixing | 05 | 20 |

| | | | |
|---|---|---|---|
| | extraction, distillation, crystallization, chemical reaction and recycle processes, Material balance equations based on conservation principle, Material balances for non-reactive processes (Unit Operations), Material balances for reactive processes. | | |
| **Section II** | | | |
| **Module No** | **Content** | **Hours** | **Weightage in %** |
| 5. | **Vapour pressure:** Vapour pressure plots, Vapour pressure of immiscible liquids and vapour pressure of solutions; Humidity and saturation humiditychart, Super saturation, Distribution of a solute between immiscible and partially miscible liquids, Solubility of gases. | 03 | 05 |
| 6. | **Thermo physics and Energy Balances:** Energy balances for closed and open systems based on energy conservation principle, Energy balances for non-reactive processes (Unit Operations), Energy balances for reactive processes, Coupled material and energy balances for single unit process, Heats of formation, combustion, reaction, solution, dilution, Effect of temperature on heat of reaction, Energy balance of systems without and with chemical reactions, Heat capacity calculations, Enthalpy changes of reactions, dissolution and laws of thermochemistry, Effect of pressure and temperature on heat of reactions. | 07 | 25 |
| 7. | **Multiple Unit Processes:** Introduction to processes with multiple Units; Material balances on processes with recycle, Purge, and bypass, Introduction to DOF analysis and solution strategy for multi-unit process, Degrees of freedom in steady-state processes, Simultaneous material and energy balance problems using flow sheeting codes, Unsteady state material and energy balances. | 05 | 20 |
| | **TOTAL** | **30** | **100** |

**List of Tutorials:**

| Sr No | Name of Tutorials | Hours |
|---|---|---|
| 1. | Tutorial – 1 – basics to Unit operations and Unit Conversion | 02 |
| 2. | Tutorial – 2- Method of least squares | 02 |
| 3. | Tutorial – 3- Dimensional analysis | 02 |
| 4. | Tutorial – 4- Material Balances | 02 |
| 5. | Tutorial – 5- Material Balances | 02 |
| 6. | Tutorial – 6- Material Balances | 02 |
| 7. | Tutorial – 7- Material Balances | 02 |
| 8. | Tutorial – 8 - Material balances for non-reactive processes | 02 |
| 9. | Tutorial – 9- Material balances for non-reactive processes | 02 |
| 10. | Tutorial – 10 - Material balances for non-reactive processes | 02 |
| 11. | Tutorial – 11 - Unsteady state material and energy balances | 02 |
| 12. | Tutorial – 12 - Unsteady state material and energy balances | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Stoichiometry | Bhatt, B.I. and Vora, S.M. | Tata McGraw-Hill Publishing Co., New Delhi. |
| Chemical Process Principles Part-I | Hougen, O.A., Watson. K.M. and Ragatz, R.A. | John Wiley & Sons, (CBS Publishers & Distributor, New Delhi). |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Basic Principles and Calculation in Chemical Engineering | Himmelblau, D.M. | Prentice Hall, Inc. |
| Introduction to Chemical Engineering | S K Ghoshal, S K Sanyal and S Dutta | Tata McGraw-Hill Publishing Co. Ltd., New Delhi. |
| Conservation of Mass and Energy | Whitwell J.C. &Jone R.K. | McGraw-Hill, Singapore, 1973 |

**Web Material Link(s):**

- http://nptel.ac.in/courses/103103039/23

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Tutorial:**

- Continuous Evaluation consists of performance of tutorial which should be evaluated out of 10 Marks for each tutorial and average of the same will be converted to 30 marks.
- Numerical Test consists of 10 marks.
- Internal Viva consists of 10 marks.

**Course Outcome(s):**

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

| SECH2210 | CHEMICAL PROCESS CALCULATIONS |
|---|---|
| CO 1 | Apply the concept of dimension and unit conversion to check dimensional consistency of balanced equations and understand the specific terms used in process calculation. |
| CO 2 | Compute material balance problems on distillation, absorption, etc without chemical reactions. |
| CO 3 | Compute material balance problems on batch and continuous process with chemical reactions. |
| CO 4 | Solve energy balance problems on heat exchanger, evaporator, etc of various unit processes. |
| CO 5 | Solve problems related to ideal and real gas and liquid solutions. |

**Mapping of CO with PO**

| SECH2210 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | | | | | | | | | | 1 |
| CO 2 | | 1 | | | 1 | | | | 1 | 1 | | 1 |
| CO 3 | | | | 1 | | | | | 1 | 1 | | 1 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 4 | | | 1 | | 1 | | | | | 1 | | 1 |
| CO 5 | 2 | 1 | | 1 | 1 | | | | | 1 | | 1 |

**Mapping of CO with PSO**

| **SECH2210** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | 1 | |
| CO 2 | 1 | 1 | |
| CO 3 | | 1 | |
| CO 4 | 1 | 1 | |
| CO 5 | 1 | 1 | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Introduction | 1,2,5 |
| 2 | Graphics and Basics of Chemical Processes | 1,2,3,4,5 |
| 3 | Basic Calculations | 3,4,5 |
| 4 | Material Balances | 3,4,5 |
| 5 | Vapour pressure | 1,2,3,4,5 |
| 6 | Thermo physics and Energy Balances | 3,4,5 |
| 7 | Multiple Unit Processes | 3,4,5 |

**P P Savani University**

**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH2220

Course Name: Mechanical Operations

Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | 02 | -- | 03 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help learner to

- understand many basic principles of Chemical Engineering operations such as Size Reduction, Filtration, Sedimentation, Mixing and Agitation etc. and their mathematical co-relation.
- understand basic principles of particle preparation and their characterization.
- study various methods for storage of solids and conveyors available for their transportation.
- understand the performance of different equipment for separation of solids and size reduction

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Properties of particulate solid**<br>Introduction to particle technology, Characterization of solid particles, particle size measurement techniques, Mixed particles,specific surface of mixture, Particle population. | 02 | 05 |
| 2. | **Size reduction and enlargement**<br>Types of equipment and their studies, Principles of comminution, Laws of crushing and grinding, Closed and open circuit grinding, power requirements, Energy and power required for comminution,Industrial processes for particle size enlargement, size enlargement equipment comminution, Broad classification, Primary breaking operations, Intermediate crushing by crushers, cone, roll and impact crushers, Ball and fumbling mills—fine grinding, Determination of power consumption. | 07 | 20 |
| 3. | **Properties of masses of solids**<br>Storage of solids: Angle of repose, bulk storage, storage in bins andsilos. | 02 | 08 |
| 4. | **Conveying of solids**<br>Codes for characterization of solids, screw conveyers, belt conveyers, bucket elevators, pneumatic conveying of solids, Designof conveyor belts, Mechanical and pneumatic conveying equipment and power consumption. | 02 | 07 |

| | | | |
|---|---|---|---|
| 5. | **Screening - equipment and efficiency**<br>Screen analysis, Method of reporting screen analysis, Capacity and effectiveness of screens, Screen analysis, sizing curves, industrial sizing, screening revolving and vibrating screens, Screen efficiency and capacity, Classification: Laws, wet and dry methods, Types of classifiers—stationary, mechanical, centrifugal and hydraulic. | 02 | 10 |
| **Section II** | | | |
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 6. | **Filtration**<br>Flow through porous media, Theories of filtration - Principles of filtration, constant rate and constant pressure filtration, Optimum cycle, compressible cakes and filter aids, constant pressure, constantrate filtration, compressible and incompressible cakes, cake resistance, filter media resistance, filter media, filter aids, filtration equipment (batch, continuous), selection criteria, washing of filter cakes, filtration by continuous vacuum and pressure filters. | 03 | 15 |
| 7. | **Gravity setting and sedimentation**<br>Gravity clarifiers, sorting clarifiers, Batch sedimentation, rate ofsedimentation, Thickening process and sedimentation, Design of thickeners and clarifiers free and hindered setting, Centrifugal sedimentation: Principles of centrifugal sedimentation, Solid gas separation, liquid solid separation, Centrifugation. | 04 | 10 |
| 8. | **Mixing**<br>Mixing equipment and characteristics, power consumption and efficiency, mixing of powders and pastes: Mixers for cohesive and non-cohesive solids, Mixing Index Agitation and mixing of liquids: Basic stirred tank design, Types of impellers, flow patterns, power consumption and scale up. | 04 | 10 |
| 9. | **Separators**<br>Cyclones and electrostatic precipitator, Flotation, Thickeners, Flotation, Physico-chemical principles, Chemistry of flotation reagents and their functions, Flotation processes, Froth flotation machines, Concentration of copper, lead and zinc ores by flotation, Flotation of non-sulphide ores of copper and lead, dolomite, fluorspar, gypsum, phosphates, manganese, silica, sillimanite, graphite and coal, Electrical and magnetic concentration, Electrostatic and magnetic separations, dry and wet type separators. | 04 | 15 |
| | **TOTAL** | **30** | **100** |

**List of Practical:**

| Sr No | Name of Practical | Hours |
|---|---|---|
| 1. | Determination of particle size by sieve analysis. | 02 |
| 2. | Determination of the optimum speed and critical speed of a ball mill. | 02 |
| 3. | Measurement of different bulk properties of powder samples. | 02 |
| 4. | To study powder compaction behaviour using different powder compaction | 02 |
| | models. | |
| 4. | Study of particle size reduction by Roll crusher and Jaw crusher | 04 |
| 5. | Characterization of powder flow ability by Angle of Repose. | 04 |
| 6. | Obtaining the collection efficiency of cyclone | 02 |
| 7. | Obtaining settling rates of slurry as function of solid concentration | 02 |
| 8. | Power consumption in Agitated vessels | 02 |
| 9. | Study of froth flotation process | 02 |
| 10. | Study of Plate and Frame filter place | 04 |
| 11. | Study of Centrifugation process | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Unit Operations of Chemical Engineering | W L McCabe and J C Smith | McGraw-Hill International |
| Principles of Mineral Dressing | A M Gaudin | Tata McGraw-Hill Publishing Co. Ltd., New Delhi |
| Elements of Ore Dressing | A F Taggart | John Wiley and Sons, New York |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering Vol.- II, 6th Ed. | J.M. Coulson & J.F. Richardson | Elsevier, 2003 or Pergamon Press |
| Unit Operations | G.G. Brown Ed. | John Wiley & Sons, 1950 |
| Transport Processes and Separation Process Principles' 4th Ed, | C.G. Geankopolis | Prentice Hall India, 2003 |

**Web Material Link(s)**:
http://nptel.ac.in/syllabus/103107091

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marksfor each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation of various topics consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| SECH2220 | MECHANICAL OPERATIONS |
|---|---|
| CO 1 | Apply and distinguish fluid particle systems and equipment. |
| CO 2 | Select suitable size reduction equipment for solid solid separation method and conveying system. |
| CO 3 | Describe and analyze agitation and mixing and their equipment. |
| CO 4 | Classify solid liquid gas separation equipment. liquid gas separation equipment. |

**Mapping of CO with PO**

| SECH2220 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 2 | 3 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 3 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 4 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |

**Mapping of CO with PSO**

| **SECH2220** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 2 | 2 | |
| CO 2 | 2 | 2 | |
| CO 3 | 2 | 2 | |
| CO 4 | 2 | 2 | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Solid Properties | 1 |
| 2 | Size Reduction | 1,2,3,4 |
| 3 | Particulate properties | 1,2,4 |
| 4 | Conveying of Solids | 1,3,4 |
| 5 | Screening | 2,4,5 |
| 6 | Filtration | 2,4,5 |
| 7 | Gravity settling | 2,4,5 |
| 8 | Mixing | 2,4,5 |
| 9 | Separators | 2,4,5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH2230
Course Name: Fluid Flow Operations
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | -- | 04 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learner to

- get the introductory idea and explanation of basic fundamentals of Fluid Flow Operations which isused in the applications of chemical engineering, Porous media movement, Aerodynamics, hydraulics, Marine Engineering, Gas dynamics etc.
- learn Fluid Properties.
- understand the importance of flow measurement and its applications in Industries and to obtain theloss of flow in a flow system.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Properties of fluids and concept of pressure**<br>Definitions of Unit operations, Basic concepts of fluids and its application, Properties of fluids (Density, Viscosity, Surface Tension, Compressibility, Capillary, Vapour Pressure, Bulk Modulus, Cavitation, Classification of Fluids), Unit Conversion, Dimensional analysis, Dimensional homogeneity, Dimensionless equations, Raleigh and Buckingham π theorem, Common π groups, Non Dimensional Numbers, Similarities – Geometrical, Kinematics and Dynamic. | 03 | 05 |
| 2. | **Fluid statics & its application**<br>Nature of fluids: Incompressible and compressible fluids, Pressure concepts, Force and Pressure, Pascal's law of Pressure at a point, Pressure measurement by Manometers – U tube, Inclined U tube and Differential, Centre of Pressure, Hydrostatic equilibrium in gravitational and centrifugal field, Hydrostatic forces on surface – Vertical, Horizontal and Inclined, Forces on curved Surfaces, Buoyancy and Buoyant Force, Centre of Buoyancy and Meta Centre, Determination of Metacentric Height, Stability of Floating and Submerged Body, Position of metacentre relative to Centre of buoyancy. Manometers, Inclined manometer, Continuous gravity and centrifugal decanter. | 04 | 10 |

| | | | |
|---|---|---|---|
| 3. | **Boundary layers & its applications**<br>Concept of Boundary Layer, Boundary layer Thickness, Momentum Thickness, Displacement Thickness, Drag and Lift, Separation ofBoundary layer, Streamlined and Bluffed Bodies. | 03 | 05 |
| 4. | **Momentum Balance and their Applications**<br>Kinematics of fluid flow, Types of flow, Steady and Unsteady Flow, Potential flow, One – two and three Dimensional Flow, Uniform andNon Uniform Flow, Rotational and Irrotational Flow, Stream Lines and Stream Function, Velocity Potential Function, Relation betweenstream and velocity potential function, Flow nets, Continuity Equation for 2D and 3D flow in Cartesian co-ordinates system , Laminar flow, Reynolds number, Newtonian and non-Newtonian fluids, Velocity gradient and Rate of shear, Expression for co- efficient of friction – DracyWeishbach Equation, Moody's Diagram resistance for smooth and rough pipes, Viscosity of gases and liquids, Turbulent flow, Nature of turbulence, Eddy viscosity, Eddy diffusivity of momentum, Flow in boundary layers, Laminar and turbulent flow in boundary layers, Boundary layer formation in straight tube and flat plates, Boundary layer thickness, Boundary layer separation and wake formation. | 04 | 10 |
| 5. | **Basic fluid equations &fluid dynamics**<br>Stream line and stream tubes, Average velocity, Mass velocity, Momentum balance, Bernoulli's equation without friction & its applications, Correction of Bernoulli's equation for fluid friction, Pump work in Bernoulli's equation. Newton's law of motion, Euler's Equation and its applications, Momentum Equation, Pitot Tube, Determination of volumetric flow with pitot tube, Principle of Venturimeter, Pipe Orifice and Rotameter. | 03 | 05 |
| 6. | **Flow of incompressible fluids through ducts and its applications in conduits and thin layers**<br>Flow of incompressible fluids in pipes, Friction factor, Laminar flow of Newtonian and non-Newtonian fluids, Turbulent flow in pipes and closed channels, Effect of roughness, Friction factor chart, Dragreduction in turbulent flow Friction factor in flow through channels of noncircular cross section, Friction from changes in velocity or direction, Effect of fittings and valves, Major and Minor Losses in Pipes, Hydraulic Gradient line and Total energy line, Equivalent Pipes, Pipes in series and parallel, Siphon, Power transmission through pipe, Moody's Diagram, Practical use of velocity heads in design, Minimization expansion and contraction losses. Flow through Open Channel: Specific Energy and Specific Force, Critical Flow, Hydraulic Jump, Measurement of Discharge in open Channels. | 06 | 15 |
| **Section II** | | | |
| **Module No.** | **Content** | **Hours** | **Weightage in %** |

| | | | |
|---|---|---|---|
| 7. | **Flow of compressible fluids and its applications**<br>Introduction to compressible flow, flow through pipes and nozzles, Fans, Blowers ejectors and compressors; Continuity equations, Velocity of sound, Stagnation temperature, Processes of compressible flow. | 05 | 10 |
| 8. | **Flow of Fluids through Solids**<br>Form drag - skin drag - Drag co-efficient. Flow around solids and packed beds. Friction factor for packed beds. Ergun's Equation - Motion of particles through fluids - Motion under gravitational and centrifugal fields - Terminal settling velocity. Fluidisation -Mechanism, types, general properties – applications | 05 | 10 |
| 9. | **Transportation and Metering**<br>Transportation of fluids, Pipes, pipe standards, fittings, pipe joints, valves and their constructional features, Fluid moving machinery: Positive displacement and centrifugal pumps, centrifugal pump theory, concept of NPSH, pump performance and characteristics, Measurement of fluid flow: Orifice meter, venturi meter, pitot tube,rotameter, weirs and notches Wet gas meter and dry gas meter, Areameters; Head meters; Mass flow meter; Hot-wire anemometer, Hot wire and hot film anemometers. | 06 | 15 |
| 10. | **Applications of fluid mechanics**<br>Pipe, fitting and valves, pumps, compressor, blowers and fans, Flow past immersed bodies: Drag, Drag coefficients, Flow through beds ofsolids, Particle motion, Terminal velocity, Hindered settling, Settlingand rise of bubbles and drops, Fluidization, Special cases of Single and two phase flow through packed beds, two-phase gas liquid flow in pipes, Essentials of gas solid flows. Introduction to computational fluid dynamics (CFD). | 06 | 15 |
| | **TOTAL** | **45** | **100** |

**List of Practical:**

| Sr No | Name of Practical | Hours |
|---|---|---|
| 1. | Determine metacentric height of floating body. | 02 |
| 2. | Measurement of pressure using different types of manometers. | 04 |
| 3. | Determine Co-efficient of Discharge by venturimeter, Orificemeter and Rotameter. | 04 |
| 4. | Verification of Bernoulli's apparatus. | 02 |
| 5. | Measurement of velocity of flow using Pitot tube. | 02 |
| 6. | Measurement of Friction factor for Different pipes & annulus. | 02 |
| 7. | Measurement of viscosity using Redwood Viscometer. | 02 |
| 8. | Determine discharge through triangular/trapezoidal / rectangular notch. | 02 |
| 9. | Determine different flow patterns by Reynolds's apparatus. | 02 |
| 10. | Measurement of lift and drag of aerofoil. | 02 |
| 11. | Measurement of static pressure distribution around aerofoil using wind tunnel. | 02 |
| 12. | Experiment on viscosity by stoke's law | 02 |
| 13. | Experiments on characteristics of centrifugal pumps | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Textbook of Fluid Mechanics and Hydraulic Machines | R. K. Bansal | Laxmi Publications |
| Introduction to Fluid Mechanics and Fluid Machines | S.K. Som& G Biswas. | Tata McGraw Hill Publication |
| Unit Operations of Chemical Engineering | McCabe W.L., Smith J.C., Harriott P. | McGraw Hill |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Fluid Mechanics | Frank M. White | Tata McGraw Hill Publication |
| Fluid Mechanics | R.K. Rajput | Schand Publication |
| Fluid Mechanics for Chemical Engineers | De Nevers N | McGraw-Hill |

**Web Material Link(s):**

- http://nptel.ac.in/courses/112105171/1

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical's:**

- Continuous Evaluation consists of performance of Practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation of various topics consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| SECH2230 | FLUID FLOW OPERATIONS |
|---|---|
| CO 1 | Describe fundamentals of fluids and its types. |
| CO 2 | Analyze various flow problems and flow characteristics for various flow conditions. |
| CO 3 | Demonstrate working of different flowmeters. |
| CO 4 | Analyze major and minor frictional losses in different pipes fittings. |
| CO 5 | Describe and observe different pumps and their performance. |

**Mapping of CO with PO**

| SECH2230 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | 1 | | | | | | | 2 | | 1 |
| CO 2 | 2 | 1 | 1 | | | | | | | | | |
| CO 3 | 1 | 1 | 1 | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 4 | 1 | 1 | | | | | | | | | | |
| CO 5 | | 1 | | 1 | | | | | | | | |

**Mapping of CO with PSO**

| **SECH2230** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | |
| CO 2 | 1 | 1 | 1 |
| CO 3 | 2 | 1 | |
| CO 4 | | 3 | |
| CO 5 | | 1 | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Basic Concept and Fluid statics & its application | 1,2 |
| 2 | Boundary layers & its applications | 2,4 |
| 3 | Kinematics of fluid flow | 2,3,4 |
| 4 | Basic fluid equations & fluid dynamics | 1,2 |
| 5 | Flow of compressible fluids and its applications | 1,2,4,5 |
| 6 | Flow of Fluids through Solids | 2,3,4 |
| 7 | Transportation | 3,4,5 |
| 8 | Flow of incompressible fluids through ducts and its applications in conduits and thin layers | 1,2,6 |
| 9 | Basic fluid equations &fluid dynamics | 2,4,5 |
| 10 | Boundary layers & its applications | 2,3,4,5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH2240
Course Name: Materials Science and Technology
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | -- | 02 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learner to

- identify the different chemicals and related materials and their properties.
- understand the microstructures, crystallography, defects, and phase diagrams of different materials.
- help the students to understand the process involved in chemical and mechanical testing of materials under certain conditions.
- make them aware about the advancements in the area of materials used in chemical and allied industries.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Introduction to Engineering Materials**<br>Classification of engineering materials, Engineering requirements from materials, Basics of crystals and their correlated properties, Factors that govern material selection for engineering applications, Micro and macro examination. | 02 | 07 |
| 2. | **Structure and Imperfections in Crystals**<br>Introduction, Unit cells and their lattice structure, coordination number, crystal structure of metals, Atomic packing factor, Crystallographic planes and directions, Polymorphism and Allotropy, Diffusion in solids, Imperfection in crystals and their types. | 03 | 03 |
| 3. | **Properties of Materials**<br>Mechanical, Electrical and magnetic properties of materials,Selection of material like SS, Ti/Zr alloy and design for corrosion control, Factors determining the choice of materials of construction in chemical industries. | 02 | 05 |
| 4. | **Ferrous metals and its Alloys**<br>Iron and their alloys - Aluminium, copper, Zinc, lead, Nickel andtheir alloys with reference to the application in chemical | 03 | 15 |

| | | | |
|---|---|---|---|
| | industries. Phase Diagrams and Phase Transformation, TTT and CCT Diagrams. Iron-Iron Carbide and Iron-carbon diagrams, Overview of different types of irons - Wrought iron Pig iron, Cast iron, White Cast Iron, Grey Cast Iron, Malleable Cast Iron and their properties and characteristics, deformation of metals, Types of steel like Chromium, Manganese, Molybdenum and Manganese steels. | | |
| 5. | **Metals: their behaviours and properties**<br>Solidification of metals and an alloy, Nucleation and Growth, Solidification defects, Effects of Structure on Mechanical Properties, Methods to control the grain structure resulting from solidification, Cooling curve of pure metal and alloy, Deformation in polycrystalline materials, Mechanical testing of materials (destructive & non-destructive) testing methods. | 03 | 12 |
| 6. | **Heat Treatment and Surface hardening processes**<br>Annealing and its types, Normalizing, Aus-tempering, Mar tempering, Quenching and Temper heat treatment, Hardenability, Applications of above processes for the industrial practices, Flame andinduction hardening, Carburizing, Nitriding and Carbonitriding, Applications of above processes for the industrial practices. | 02 | 08 |
| **Section II** | | | |
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 7. | **Polymers, Ceramics, and Composites:**<br>Methods of fabrication of materials like timber, plastics, rubber,fibres and other polymeric materials, Ceramics, Ceramic Matrix,Crystalline and non-crystalline ceramic systems, Properties of ceramic materials, Glass and refractories, Cement refractories, Alumina, Zirconia, Silicon Carbide, Sialons, Reaction Bonded Silicon Nitride, Processing Composite materials, Fibre reinforced plastic (FRP), Organic materials like wood, plastics, and rubber, Advanced materials like Biomaterials and composites with special reference to the applications inchemical Industries, Polymers - Definition, Classification & characteristics, Types of polymerization, Polymer processing, Smart polymer, Advanced polymer Conductive polymer, bio-route prepared nano polymer, Blended polymer, self-cleaning polymer surfaces. | 04 | 15 |
| 8. | **Membrane Materials and modules**<br>Membrane and their types, Membrane Materials, Modules andtheir types, method of preparation of various membranes, Industrial applications. | 03 | 10 |
| 9. | **Applications of advance materials in chemical Engineering**Colloidal Materials and Their Industrial Applications, Surfactants, Mixed surfactants, Micelles, Vesicles, Micelles, Reverse micelles, Emulsions, Macroemulsions, foams, Thin Films, microbial polymers**,** green solvents, | 05 | 15 |

| | | | |
|---|---|---|---|
| | Industrial enzymes, Protein as Enzymes, Gels and Smart Hydrogels like Hydrogel, Core and shell hydrogel, shell and core hydrogel, green hydrogel, stimuli responsiveness hydrogel. | | |
| 10. | **Nano materials**<br>Metal and Semiconductor Nano materials, Quantum Dots, Wellsand Wires, Molecule to bulk transitions, Bucky balls and Carbon Nano tubes, Nano composite, Molecular machines, Nanofactories, Nanocatalysts, Nanocomposites, Bio-analytical tools, Nano/micro arrays, Nano devices, lab-on-a-chip etc. | 03 | 10 |
| | **TOTAL** | **30** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Materials Science and Metallurgy | O. P. Khanna | Dhanpatrai Publication |
| Chemical Engineering Materials | Rumford F. | Constable and Company Limited, 2nd Edition, 1987 |
| Membrane Separation Processes | Kaushik Nath | PHI Pvt. Ltd., 2008 |
| Principles of Colloid and Surface Chemistry, 3rd Edn. | Hiemenz, P. C., and R. Rajgopalan | Marcel Dekker, NY, 1997. |
| Nano chemistry A chemical approach to nanomaterials | Ozin G. A, Andre C. Arsenault | Royal society of chemistry, UK,2005. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Callister's Material Science and Engineering | R. Balasubramanian | Wiley India |
| Chemical Engineering Materials | Chaudhry H. | Indian Book Distributing Company, 2nd Edition, Delhi, 1982 |

**Web Material Link(s):**

- http://nptel.ac.in/downloads/113106032/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

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

| SECH2240 | Materials Science and Technology |
|---|---|
| CO 1 | Enable understanding of crystal structure of various materials. |
| CO 2 | Analyze microstructures, crystallography and defects of different chemical engineering materials and metals |
| CO 3 | Classify the metallurgy of ferrous and non ferrous metals and alloys. |
| CO 4 | Define the basics of polymers and composite material. |

**Mapping of CO with PO**

| **SECH2240** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | | 3 | | | 3 | | | 1 | | |
| CO 2 | 1 | | | 1 | | | 3 | | | 3 | | |
| CO 3 | 1 | | | 2 | | | | | | 3 | | |
| CO 4 | 1 | | | 1 | | | | | | | | |

**Mapping of CO with PSO**

| **SECH2240** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 3 | 3 | 2 |
| CO 2 | 3 | 3 | 3 |
| CO 3 | | | |
| CO 4 | | | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Introduction to Engineering Materials | 1,2 |
| 2 | Structure and Imperfections in Crystals | 2,3 |
| 3 | Properties of Materials | 4 |
| 4 | Metals: their behaviours and properties | 2,3,4 |
| 5 | Heat Treatment and Surface hardening processes | 2,3,4 |
| 6 | Powder Metallurgy | 2,5 |
| 7 | Polymers, Ceramics, and Composites | 1,2,3 |
| 8 | Membrane Materials and modules | 1,2 |
| 9 | Applications of advance materials in chemical Engineering | 3,5,6 |
| 10 | Nano materials | 3,5,6 |

**P P Savani University**
**School of Engineering**
**Department of Science & Humanities**

Course Code: SESH2120
Course Name: Numerical Method & Statistics
Prerequisite Course(s): SESH2110- Differential Methods and Complex Variable

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | - | 02 | 05 | 40 | 60 | - | - | 100 | 00 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learner to

- provide the knowledge of numerical analysis & statistical methods to the students.
- mentally prepare the students to identify and formulate the engineering problem and obtain their solution.
- inculcate the analytical skill of the students to apply the Numerical & Statistical techniques to the problems of respective field.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Approximations and Errors:** Errors and Their computations, General error formula. **Solution of Algebraic and Transcendental Equations:** Bracketing Methods (Bisection, Secant, Method of False Position), Convergence of Iterative Methods, Newton-Raphson Method, Newton-Raphson Method | 7 | 17 |
| 2. | **Numerical Solutions of Linear Equations** Gauss-Seidel Method Iteration Method, Jacobi's Method, Gauss-SeidelMethod, Eigen Value Problem. | 6 | 13 |
| 3. | **Numerical Differentiation and Integration** Finite Differences: Forward, Backward and Divided Differences Table,Newton's Forward, Backward and Divided Differences Interpolation Formula, Interpolation Polynomials, Lagrange Interpolation Formula Interpolation, Numerical Integration, Trapezoidal Rule, Simpson's 1/3-rule, Simpson's 3/8-rule. | 10 | 20 |
| **Section II** | | | |
| Module | Content | Hours | Weightage in % |
| 1. | **Numerical Methods for ODEs**: Taylor's Series and Euler's Method, Modifications and Improvements in Euler's Method, Runge-Kutta 2nd Order & 4th Order Methods, Milne's Predictor-Corrector Methods, Boundary Value Problems. | 7 | 16 |

| | | | |
|---|---|---|---|
| 2. | **Basics of Statistics**<br>Elements, Variables, Observations, Quantitative and Qualitative data, Cross-sectional and Time series data, Frequency distribution, Dot plot, Histogram, Cumulative distribution, Measure of location, Mean, Median, Mode, Percentile, Quartile, Measure of variability, Range, Interquartile Range, Variance, Standard Deviation, Coefficient of Variation, Regression line and regression coefficient, Karl Pearson's method | 7 | 16 |
| 3. | **Probability Distribution**<br>Introduction, Conditional probability, Independent events, independent experiments, Bayes' theorem, Probability distribution, Binomial distribution, Poisson distribution, Normal distribution. | 8 | 18 |

**List of Tutorials:**

| Sr. No. | Name of Tutorial | Hours |
|---|---|---|
| 1. | Approximations and Errors | 2 |
| 2. | Solution of Algebraic and Transcendental Equations | 4 |
| 3. | Numerical Solutions of Linear Equations | 2 |
| 4. | Numerical Differentiation and Integration-1 | 2 |
| 5. | Numerical Differentiation and Integration-2 | 2 |
| 6. | Ordinary Differential Equations-1 | 2 |
| 7. | Ordinary Differential Equations-2 | 4 |
| 8. | Basics of Statistics-1 | 4 |
| 9. | Basics of Statistics-2 | 2 |
| 10. | Probability-1 | 4 |
| 11. | Probability-2 | 2 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Advanced Engineering Mathematics | Erwin Kreyszig | Wiley India Pvt. Ltd.<br>New Delhi. |
| Probability and Statistics for Engineers | Richard A. Johnson<br>Irwin Miller, John Freund | Pearson India Education Services Pvt. Ltd., Noida. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Numerical Methods in Engineering & Science | B. S. Grewal | Khanna Publishers, New Delhi |
| Advanced Engineering Mathematics | R. K. Jain, S. R. K. Iyengar | Narosa Publishing House, New Delhi. |
| Introductory Methods of Numerical Analysis. | S. S. Sastry | PHI Learning Pvt. Ltd., New Delhi. |
| Statistics for Business and Economics | David R. Anderson, Dennis J. Sweeney | Cengage Learning |

**Web Material Link(s):**

- http://nptel.ac.in/courses/111106094/
- http://nptel.ac.in/courses/111105035/
- http://nptel.ac.in/courses/111101003/
- http://nptel.ac.in/courses/111105090/
- http://nptel.ac.in/courses/111107105/
- http://nptel.ac.in/courses/110107114

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Tutorial:**

- Continuous Evaluation consists of performance of tutorial which will be evaluated out of 10 marks for each tutorial and average of the same will be converted to 30 marks.
- MCQ based examination consists of 10 marks.
- Internal Viva consists of 10 marks.

**Course Outcome(s):**

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

| **SESH2120** | **NUMERICAL METHODS & STATISTICS** |
|---|---|
| CO 1 | Derive numerical solution of linear and nonlinear system of equation. |
| CO 2 | Acquire knowledge of finite differences, interpolation, numerical differentiation andnumerical integration. |
| CO 3 | Compare variety of numerical methods for solving ordinary differential Equation. |
| CO 4 | Construct different statistical methods to collect, compare, interpret & evaluate data. |
| CO 5 | Apply probability in decision making, artificial intelligence, machine learning etc. |

**Mapping of CO with PO**

| **SESH2120** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | | 1 |
| CO 2 | 2 | 1 | 1 | 2 | | | | | | | | 1 |
| CO 3 | 2 | 2 | 1 | 1 | | | | | | | | 1 |
| CO 4 | 2 | 1 | 1 | 1 | | | | | | | | 1 |
| CO 5 | | | | | | | | | | | | |

**Mapping of CO with PSO**

| **SESH2120** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | 2 | |
| CO 2 | | 2 | |
| CO 3 | | 2 | |
| CO 4 | | 2 | |
| CO 5 | | | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Solution of Algebraic and Transcendental Equations | 1, 2, 3, 4, 6 |
| 2 | Numerical Solutions of Linear Equations | 1, 2, 3, 5 |
| 3 | Numerical Differentiation and Integration | 1, 2, 3, 5 |
| 4 | Numerical Methods for ODEs | 1, 2, 3, 5, 6 |
| 5 | Basics of Statistics | 1, 2, 3, 4, 5 |
| 6 | Probability Distribution | 1, 2, 3, 4, 5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH2250
Course Name: Heat Transfer Operations
Prerequisite Course(s): -

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | -- | 04 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand the basic concepts of conduction, convection and radiation heat transfer.
- understand how to formulate and be able to solve one- and two-dimensional conduction heat transfer problems.
- apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient.
- understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation and evaluate radiation view factors using tables and the view factor relationships.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Introduction**<br>Modes of heat transfer - Conduction, Convection and Radiation,Material Properties of Importance in Heat Transfer – Thermal conductivity & Specific Heat Capacity. | 03 | 05 |
| 2. | **Conduction: One Dimensional**<br>Steady State Conduction through Constant Area, Thermal ContactResistance, Steady State Heat Conduction through a Variable Area –Cylinder & Sphere, Heat Conduction in Bodies with Heat Sources. | 04 | 10 |
| 3. | **Convective Heat Transfer: One Dimensional**<br>Principle of Heat Flow in Fluids and Concept of Heat Transfer Coefficient, Individual and Overall Heat Transfer Coefficient, Heat Transfer between Fluids Separated by a Flat Solid Wall & Separatedby a Cylindrical Wall, Enhanced Heat Transfer: Concept of Fins - Analytical Solution of Different Cases and Fin Efficiency, Thermal Insulation. | 06 | 15 |
| 4. | **Forced Convective Heat Transfer**<br>Principle of Convection, Forced Convection Mechanism: Flow overa Flat Horizontal Plate**,** Flow through a Pipe or Tube - Turbulent | 06 | 10 |

| | | | |
|---|---|---|---|
| | flow, Laminar flow, Flow through a Non-Circular duct, Flow over a Flat Plate, Flow over Cylinders and Spheres (Flow across a Cylinder,Flow across a Sphere, Flow across a Bank of tubes), Momentum andHeat Transfer Analogies - Reynolds Analogy, The Chilton-Colburn Analogy, The Prandtl Analogy, The Van Karman Analogy. | | |
| 5. | **Heat Transfer by Natural Convection**<br>Introduction, Empirical Correlations for Natural-Convective Heat Transfer - Natural Convection around a Flat Vertical Plate, Horizontal Cylinder, Horizontal Flat Surface, Sphere and Enclosure, Combined Natural and Forced Convection. | 04 | 10 |
| **Section II** | | | |
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 6. | **Heat Transfer in Boiling and Condensation**<br>Heat Transfer during Boiling, Boiling of Saturated Liquid - Nucleation Boiling, Maximum Heat Flux, Film Boiling, Heat Transfer during Condensation, Film Condensation, Condensation for Horizontal Tube - Condensation Outside Horizontal Tube or Bank of tube, Single Horizontal Tube, Vertical Tube of N Horizontal Tubes, Condensation inside a Horizontal Tube, Condensation for Packed and Fluidized bed. | 06 | 10 |
| 7. | **Radiation Heat Transfer**<br>Basic Definition Pertaining to Radiation - Emissive Power, Radiosity, Irradiation, Absoptivity, Reflectivity, and Transmissivity,Blackbody Radiation - Planck's law, Wien's law, The Stefan- Boltzmann law for Blackbody, Special Characteristic of Blackbody Radiation, Kirchhoff's law, Grey Body, Radiative Heat Exchanger between Surfaces - View Factor, Relation between View Factors, Heat Exchange between Non Blackbodies, Radiation Shield, Electrical Network for Radiation through Absorbing and Transmitting medium, Radiation Combined with Conduction and Convection. | 06 | 10 |
| 8. | **Heat Exchangers**<br>Elements of Shell and Tube Heat Exchanger, Thermal Design of HeatExchangers - Overall Heat Transfer Coefficient, Fouling Factor or Dirt Factor, Temperature Profiles in Heat Exchangers, LMTD Correction Factor, Individual Heat Transfer Coefficient, Pressure Drop in the Heat Exchanger, Correlation for Tube Side Pressure drop, Correlation for Shell Side Pressure Drop, Heat Transfer Effectiveness and Number of Transfer Units, Calculation and Designing of the Double-Pipe Heat Exchanger and Shell and Tube Heat Exchanger. | 06 | 20 |
| 9. | **Evaporators**<br>Solution Properties – Concentration, Foaming, Degradation due to High Temperature, Scaling, Equipment Material – Evaporator, Natural Circulation Evaporator, Forced Circulation Evaporator, Falling Film Evaporator, Performance of Steam Heated TubularEvaporators - Capacity and Economy - Single and Multiple Effect Evaporators, Boiling Point Elevation, Temperature Profile in an Evaporators, Method of Feeding: Multiple Effect Evaporators, Enthalpy Balance - Single Effect Evaporator, Effect of Heat of Dilution. | 04 | 10 |
| | **TOTAL** | **45** | **100** |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | To determine Heat Transfer through Composite Wall at different temperature. | 02 |
| 2. | Determination of Thermal Conductivity of Insulating Powder (Asbestos Powder). | 02 |
| 3. | To find out Heat transfer in Double Pipe Heat Exchanger in Laminar Flow and Turbulent Flow. | 04 |
| 4. | Calculation of Heat transfer Coefficient by Natural and Forced Convection | 04 |
| 5. | Heat Transfer Calculation in Plate Heat Exchanger | 04 |
| 6. | Shell and Tube Heat Exchanger | 02 |
| 7. | Heat Transfer by Radiation: Stefan-Boltzmann Law | 02 |
| 8. | Heat Transfer in Agitated Vessel | 02 |
| 9. | Heat Transfer in Drop and Film wise Condensation Apparatus | 04 |
| 10. | Pin-Fin Apparatus | 04 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Heat Transfer | Holman J. P | Mc Graw-Hill |
| Heat Transfer: Principles and Applications | Dutta B. K | PHI |
| Process Heat Transfer | Kern D. Q | Tata Mc Graw-Hill Edition |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Unit Operations of Chemical Engineering | W. L., Smith, J. C., and Harriott | McGraw-Hill |
| Chemical Engineering - Vol. I. | Coulson, J.M., Richardson, J.F. | Pergamon and ECBS, 1970 |
| Heat Transfer | Chapman, A.J. | Maxwell Macmillan International Edition, 1984 |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103103032/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marksfor each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 mark.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

**Course Outcome(s)**

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

| SECH2250 | HEAT TRANSFER OPERATION |
|---|---|
| CO 1 | Describe and classify different heat transfer process and its mode. |
| CO 2 | Able to solve conduction, convection and radiation problems. |
| CO 3 | Describe industrial applications and regimes involved in boiling and condensation. |
| CO 4 | Predict extend of heat flow by radiation through grey, white and real surfaces. |
| CO 5 | Categorize different types of evaporators with performance evaluation and to analyze material and energy balance for single and multi-effect systems. |

**Mapping of CO with PO**

| SECH2250 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 1 | | | | | | 2 | 2 | | 2 |
| CO 2 | 3 | 2 | 3 | | | | | | 2 | 2 | | 3 |
| CO 3 | 2 | 2 | 1 | | | | | | 2 | 3 | | 2 |
| CO 4 | 2 | 2 | 1 | | | | | | 2 | 2 | | 3 |
| CO 5 | 2 | 2 | 1 | | | | | | 2 | 3 | | 3 |

**Mapping of CO with PSO**

| SECH2250 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 3 | 3 | |
| CO 2 | 2 | 2 | 3 |
| CO 3 | 2 | 1 | 1 |
| CO 4 | 3 | | 1 |
| CO 5 | 3 | 2 | 3 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction | 1,2 |
| 2 | Conduction: One Dimensional | 2,3 |
| 3 | Convective Heat Transfer: One Dimensional | 1,3,5 |
| 4 | Forced Convective Heat Transfer | 2,3,5 |
| 5 | Heat Transfer by Natural Convection | 1,3 |
| 6 | Heat Transfer in Boiling and Condensation | 1,3,5 |
| 7 | Radiation Heat Transfer | 3,4,5 |
| 8 | Heat Exchangers | 3,4,5 |
| 9 | Evaporators | 2,3,4,5 |

**P P Savani University**

**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH2260
Course Name: General Chemical Technology
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | 02 | -- | 03 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help learners to

- understand various chemical allied industries and their operations.
- know the wide field of chemical engineering in various sectors.
- get basic knowledge of industries like chlor-alkali, petrochemicals, pesticides, cement etc.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Fuel and Energy**<br>Classification of Fuel, Various Types of Coal, Coal as Chemical FeedStock, Coal Carbonization and Coke Oven Plant, Gasifiers, Gasification of Coal, Petro coke And Biomass. | 03 | 10 |
| 2. | **Chlor-Alkali Industry**<br>Production of Common Salt, Caustic Soda, Chlorine, HydrochloricAcid and Soda Ash. | 03 | 10 |
| 3. | **Pulp and Paper Industries**<br>Raw Materials, Pulping Processes, Stock Preparation and Paper Making, Chemical Recovery from Black Liquor. | 03 | 10 |
| 4. | **Pesticides Industries**<br>Processes for Manufacturing of Insecticides, Fungicides andHerbicides. | 02 | 05 |
| 5. | **Polymer and Synthetic Fibre Industries**<br>Introduction to Polymerization, Commodity Polymers, Rayon, Polyester, Polyamide, Acrylic Fibre and Nylons. | 04 | 15 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |

| | | | |
|---|---|---|---|
| 6. | **Petrochemicals and Petro Industries**<br>Origin, Occurrence and Characteristics of Crude Oil, Crude Oil Distillation and Secondary Processing, Manufacturing Processes of Formaldehyde, Acetaldehyde, Acetic acid, Acetic Anhydride, Maleic Anhydride, Nitrobenzene, Ethylene Oxide, Ethylene Glycol. | 03 | 10 |
| 7. | **Industrial Gases**<br>Technology Options of Producing Producer Gas, Syn gas, Pyro gas,Nitrogen, Oxygen and Carbon dioxide. | 02 | 10 |
| 8. | **Oil, Fat, Soap and Detergent Industries**<br>Vegetable Oil Extraction Method using Mechanical and Solvent Extraction Process, Hydrogenation of oil, Introduction to Soap and Detergent, Soap Making and Recovery of Glycerine, Synthetic Detergent and Linear Alkyl Benzene. | 03 | 10 |
| 9. | **Fermentation Industry**<br>Introduction to Sugar, Fermentation Industry and Manufacture of Alcohol, Ethanol as Biofuel and Chemical Feed Stock. | 02 | 05 |
| 10. | **Cement & Glass Manufacturing Industries**<br>Lime Stone Beneficiation and Manufacturing of Cement, Types ofCement, Manufacturing of Glass, Types of Glass. | 02 | 05 |
| 11. | **Sulphur, Phosphorus and Nitrogen Industries**<br>Origin and Extraction of Sulphur, Production Routes of Suphuric Acid and Oleum, Manufacturing of Phosphorus, Phosphoric Acid and Phosphatic Fertilizers, Manufacturing of Ammonia, Nitric Acid, Nitrogenous and Mixed Fertilizers. | 02 | 10 |
| | **TOTAL** | **30** | **100** |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | To check the hardness of given water sample. | 02 |
| 2. | To determine the loss on igniting the cement sample. | 01 |
| 3. | To determine the total silica in the given sample. | 02 |
| 4. | To determine the amount of potassium in the given sample of fertilizer. | 04 |
| 5. | To determine the total insoluble residue in the cement sample. | 04 |
| 6. | To determine % available chlorine in bleaching powder. | 04 |
| 7. | To determine the amount of calcium in the given sample of fertilizer volumetrically | 04 |
| 8. | Determine the acid value of the given sample of oil. | 04 |
| 9. | Preparation of detergent. | 01 |
| 10. | Preparation of Boric acid by acidified solution of Borax ($Na_2B_4O_7$). | 02 |
| 11. | Preparation of $CaCl_2$ from HCl and lime ($CaCO_3$). | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Dryden's Outlines of Chemical Technology - 3rd Edition | Gopala Rao. M. and Marshall Sittig | East-West Press, New Delhi, 2008 |
| Shreve's Chemical Process Industries | George. T Austin | McGraw-Hill International Editions, Singapore, 1984 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical vol. I, II, III, & IV | Chemical Engineering Education Development Centre | IIT Madras, 1975-78. |
| Introduction to Chemical Equipment Design: Mechanical Aspects | Bhattacharyya, B C. | CBS Publisher, 2012 |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103103027/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marksfor each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam

**Course Outcome(s):**

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

| SECH2260 | General Chemical Technology |
|---|---|
| CO 1 | Recall fundamental principles of chemical engineering involved in process technology, including material balances, energy balances, and unit operations. |
| CO 2 | Demonstrate comprehension of the interplay between different unit operations inchemical processes, and analyze how changes in operating conditions impact process performance and product quality. |
| CO 3 | Apply theoretical knowledge to solve practical problems encountered in chemical process industries. |
| CO 4 | Analyze complex chemical processes by breaking them down into component unitoperations. |
| CO 5 | Critically assess the sustainability and environmental impact of chemical processes, considering factors such as energy consumption, waste generation, and raw material Utilization. |

**Mapping of CO with PO**

| SECH2260 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 2 | 1 | | | | | 2 | 2 | | 3 |
| CO 2 | 2 | 2 | 2 | 3 | | | | | 2 | 3 | | 2 |
| CO 3 | 2 | 1 | 3 | 2 | | | | | 3 | 2 | | 1 |
| CO 4 | 3 | 3 | 3 | 1 | | | | | 3 | 3 | | 2 |
| CO 5 | 2 | 3 | 3 | 3 | | | | | 3 | 3 | | 3 |

**Mapping of CO with PSO**

| SECH2260 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 2 | 1 | 2 |
| CO 2 | 3 | 3 | 3 |
| CO 3 | 3 | 1 | 2 |
| CO 4 | 2 | 2 | 1 |
| CO 5 | 3 | 2 | 3 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Fuel and Energy | 1,2 |
| 2 | Chlor-Alkali Industry | 1,2,5,6 |
| 3 | Pulp and Paper Industries | 1,2,5,6 |
| 4 | Pesticides Industries | 1,2,5,6 |
| 5 | Polymer and Synthetic Fibre Industries | 1,2,6 |
| 6 | Petrochemicals and Petro Industries | 1,2,5,6 |
| 7 | Industrial Gases | 1,2,5,6 |
| 8 | Oil, Fat, Soap and Detergent Industries | 1,2,5,6 |
| 9 | Fermentation Industry | 1,2,6 |
| 10 | Cement & Glass Manufacturing Industries | 1,2,5,6 |
| 11 | Sulphur, Phosphorus and Nitrogen Industries | 1,2,5,6 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH2270
Course Name: Chemical Engineering Thermodynamics-I
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | 02 | 04 | 40 | 60 | -- | -- | 100 | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help the learners to

- understand and appreciate thermodynamics as applied to various Chemical Engineering Processes.
- avail practical experience on the principles, viz., thermodynamic laws, Solution thermodynamics,Phase equilibrium and reaction equilibrium.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Introduction to the laws of Thermodynamics:** Concept of Equilibrium, Entropy & Gibbs Free Energy, Laws of Thermodynamics (Open and Closed Systems) and Equations ofChange (dU, dH, dA, dG). | 04 | 10 |
| 2. | **Properties of pure fluids:** PVT behavior including EOS for mixtures; Fugacity estimation/ calculations based on PVT behavior, Heat effects accompanying chemical Reactions. Phase equilibrium criteria and VLE calculations for different pressure ranges including flash calculations. | 03 | 15 |
| 3. | **Estimation of VLE data:** Fugacity, Fugacity Coefficient, Activity, Activity Coefficient, Activity coefficient calculation from experimental VLE data and data reduction, applications of Gibbs-Duhem relation for calculations of and consistency check for VLE data. | 05 | 10 |
| 4. | **Phase Diagrams in Thermodynamics:** Phase diagrams for miscible, partially miscible and immiscible liquid mixtures, introduction to LLE and VLE calculations. | 03 | 15 |
| | **Section II** | | |
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 5. | **Thermodynamic Properties of Solutions:** Introduction to fugacity and activity, Activity Coefficients-Partial | 09 | 30 |

| | | | |
|---|---|---|---|
| | molar properties- miscible system, immiscible system, Chemical potential as a partial molar property-Lewis randall rule-Roults and Henry's law-Gibbs Duhem Equation Mathematical relation among thermodynamic functions, Maxwell's relations, Interrelation between H, S, U, G, Cp, Cv, properties of single- and two-phase system.Types of thermodynamic diagrams. Partially immiscible system, testing of vapor-liquid equilibrium data, Van Laar equation. Margules equation, Redlich-Kister equation, P-X-Y, T-X-Y, & X-Y Diagram, vapor-liquid equilibrium of ideal and non-ideal solution. | | |
| 6. | **Refrigeration and liquefaction:** Carnot refrigerator, Vapour compression cycle, Absorption refrigeration, Choice of refrigerant, Heat pump, Liquefactionprocesses. | 06 | 20 |
| | **TOTAL** | **30** | **100** |

**List of Tutorials:**

| Sr No | Name of Tutorials | Hours |
|---|---|---|
| 1. | Tutorial – 1 (Entropy & Gibbs Free Energy) Calculation | 02 |
| 2. | Tutorial – 2 (Fugacity estimation) Calculation | 04 |
| 3. | Tutorial – 3 (Phase equilibrium criteria) Calculation | 04 |
| 4. | Tutorial – 4 (Fugacity Coefficient) Calculation | 04 |
| 5. | Tutorial – 5 (Activity Coefficient) Calculation | 02 |
| 6. | Tutorial – 6 (Henry's law-Gibbs Duhem Equation) Calculation | 02 |
| 7. | Tutorial – 7 (Maxwell's relations) Calculation | 04 |
| 8. | Tutorial – 8 (Carnot refrigerator) Calculation | 04 |
| 9. | Tutorial – 9 (Vapour compression cycle) Calculation | 02 |
| 10. | Tutorial – 10 (Absorption refrigeration) Calculation | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Introduction to Engineering Thermodynamics | J.M. Smith, Hendrick Van Ness, Michael M. Abbott, | McGraw Hill, New York, 2005. |
| Chemical Engineering Thermodynamics | S. Sundaram | Ahuja Publishers, New Delhi, 2001 |
| A Textbook of Chemical Engineering Thermodynamics | K.V. Narayanan | PHI Learning, 2004 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering Thermodynamics | B.F. Dodge | McGraw Hill, New York, 1971. |
| Chemical Engineering Thermodynamics | Y.V.C. Rao | Universities Press (1997) |
| Chemical Process Thermodynamics 3rd Ed, | B.G. Kyle | Prentice Hall India, 1994 |

**Web Material Links:**

- http://nptel.ac.in/courses/103106070/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Tutorial:**

- Continuous Evaluation consists of performance of Tutorial which should be evaluated out of 10 marks for each Tutorial and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation of various topics consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| SECH2270 | **CHEMICAL ENGINEERING THERMODYNAMICS-I** |
|---|---|
| CO 1 | Relate the terminology associated with engineering thermodynamics. |
| CO 2 | Evaluate changes in different thermodynamic properties for pure fluids using eos. |
| CO 3 | Correlate experimental vle data of pure component and ideal mixtures with suitable equations. |
| CO 4 | Calculate feasibility of reaction, heat of reaction, extent of reaction & equilibrium composition. |
| CO 5 | Construct to devise a technically feasible refrigerator for wide applications. |

**Mapping of CO with PO**

| SECH2270 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | | | | 2 | | | | | 1 | |
| CO 2 | 2 | | | | | 2 | | | | | | |
| CO 3 | 2 | 1 | | | | 2 | | | | | 2 | |
| CO 4 | 3 | 1 | | | | 2 | | | | | 2 | |
| CO 5 | 2 | 1 | | | | 2 | | | | | | |

**Mapping of CO with PSO**

| SECH2270 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | | |
| CO 2 | | 1 | |
| CO 3 | | 2 | |
| CO 4 | | 2 | |
| CO 5 | | 1 | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction to the laws of Thermodynamics | 1,2 |
| 2 | Properties of pure fluids | 2,3 |
| 3 | Estimation of VLE data | 3,4,5 |
| 4 | Phase Diagrams in Thermodynamics | 4 |
| 5 | Thermodynamic Properties of Solutions | 4,5,6 |
| 6 | Refrigeration and liquefaction | 5,6 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH2280
Course Name: Mass Transfer Operations - I
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | -- | 04 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help the learners to

- learn the concept of diffusion in gas, liquid & solid.
- understand the basics of inter-phase mass transfer.
- learn application of gas-liquid operation and simultaneous heat and mass transfer operations.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Introduction**<br>Introduction to Mass Transfer Operation, Classification of masstransfer | 02 | 05 |
| 2. | **Diffusion**<br>Introduction**,** Molecular diffusion, Flux, Models of diffusion, Fick's law, Molecular and eddy diffusion, Molecular diffusion in gases, Steady state molecular diffusion in a binary mixture through constant area - fluids at rest and laminar condition and for gases, A diffusing in non-diffusing B, equimolar counter current diffusion forgases, A diffusing in non-diffusing B, equimolar counter current diffusion for liquids, Diffusion in solids, Some special types of diffusion in solids. | 10 | 20 |
| 3. | **Mass Transfer Coefficients and Analogy Equations**<br>Introduction, Types of mass transfer coefficients, Dimensionlessgroups in mass transfer, Analogy between momentum, heat and mass transfer, Mass transfer coefficients for simple geometrical shapes. | 06 | 15 |
| 4. | **Interphase Mass Transfer**<br>Introduction, Theories of interphase mass transfer – two film,penetration, surface renewal and boundary layer theory. | 04 | 10 |
| **Section II** | | | |
| **Module** | **Content** | **Hours** | **Weightage** |

| No. | | | in % |
|---|---|---|---|
| 5. | **Humidification and dehumidification**<br>Introduction, Terminologies used, Adiabatic saturation temperature,Wet-bulb temperature, Operation involving gas-liquid contact, Water cooling, Adiabatic Humidification – Cooling, Cooling range and approach, Nonadiabatic operations – evaporative cooling, Equipment for air-water contact, some accessories and operational features of cooling tower. | 09 | 15 |
| 6. | **Drying**<br>Introduction, Drying Equilibria, Some important terminologies, Mechanism and Theory of drying, Drying rate curve- Constant Rate period, Cross circulation, falling rate and through circulation, Continuous drying, Rate of batch drying – Cross circulation and through circulation, Rate of continuous drying, Batch driers – directand indirect driers, Continuous driers – direct and indirect driers, selection of driers. | 07 | 20 |
| 7. | **Crystallization**<br>Introduction, Solid Liquid equilibria, Solubility data, Supersaturation, Material and energy balance, Crystallization process, Method of nucleation, Crystal growth, Mier's supersaturation theory, Fractional crystallization, crystallization and precipitation, Caking of crystals , Crystallization equipment, Working principle of crystallizers like agitated batch, Swenson-walker, Circulating liquor and magma, Melt crystallization – Suspension based and progressive freezing, Purification, Reactive crystallization. | 07 | 15 |
| | **TOTAL** | **45** | **100** |

**List of Practical:**

| Sr No | Name of Practical | Hours |
|---|---|---|
| 1. | Solid In Air Diffusion (Vaporization Of Naphthalene Balls) | 02 |
| 2. | To determine the rate of drying for rotary dryer for different air flow rates & different air inlet temperatures. | 04 |
| 3. | Mass Transfer With/Without Chemical Reaction (Solid-Liquid System – Dissolution Of Benzoic Acid In Aqueous NaOH Solution) | 04 |
| 4. | To calculate the mass transfer coefficient in the Humidification and Dehumidification column. | 04 |
| 5. | To perform Spray Drying. | 02 |
| 6. | Vapour In Air Diffusion - To determine the diffusion coefficient of an organic vapor (i.e. $CCl_4$) in air. | 02 |
| 7. | To study mass transfer operation in water cooling tower for different flow & thermos dynamic conditions. | 04 |
| 8. | Liquid – Liquid Diffusion - To study the effect of temperature on the diffusion coefficient. | 04 |
| 9. | Natural Draft Tray Dryer - To perform drying test on solids & heat and mass transfer analysis of a drying process. | 02 |
| 10. | To study Swenson Walker crystallizer. | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Mass Transfer – Principles and Operations | A.P. Sinha and Parameshwar De | PHI Learning Private Limited, New delhi |
| Mass Transfer concepts | K Ashokan | Universities Press |

| | | |
|---|---|---|
| Unit Operations of Chemical Engineering | W L McCabe and J C Smith. | McGraw-Hill International |
| Mass Transfer Operations | Trebal, R.E. | McGraw-Hill, Inc. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering Vol.- II, 6th Ed. | J.M. Coulson & J.F. Richardson | Elsevier, 2003 or Pergamon Press. |
| Unit Operations | G.G. Brown Ed. | John Wiley & Sons, 1950 |
| Transport Processes and Separation Process Principles' 4th Ed | C.G. Geankopolis | Prentice Hall India, 2003. |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103103035/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical/Tutorial:**

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marksfor each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| SECH2280 | MASS TRANSFER OPERATIONS - I |
|---|---|
| CO 1 | Identify and demonstrate different mass transfer mechanism such diffusion. |
| CO 2 | Explain and describe different mass transfer theories and analogies. |
| CO 3 | Classify industrial dryers &crytallizers. |
| CO 4 | Apply the knowledge of humidification & dehumidification to solve industrial problem in drying & crystalliation. |

**Mapping of CO with PO**

| SECH2280 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 1 | 1 | | | | | | | | 1 |
| CO 2 | 3 | 2 | 1 | | | | | | | | | 1 |
| CO 3 | 3 | 2 | 1 | 1 | | | | | | | | |
| CO 4 | 3 | 2 | 1 | | | | | | | | | 1 |

**Mapping of CO with PSO**

| SECH2280 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | |
| CO 2 | 1 | 1 | |
| CO 3 | 1 | 2 | |
| CO 4 | 1 | | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction | 2,3 |
| 2 | Diffusion | 1,2 |
| 3 | Mass Transfer Coefficients and Analogy Equations | 2,3,4 |
| 4 | Interphase Mass Transfer | 4,5 |
| 5 | Humidification and dehumidification | 4,5 |
| 6 | Drying | 2,3,4 |
| 7 | Crystallization | 2,3,4 |

# THIRD YEAR B.TECH

**P P SAVANI UNIVERSITY**

**SCHOOL OF ENGINEERING**

**TEACHING & EXAMINATION SCHEME FOR THIRD YEAR B.TECH. PROGRAMME AY: 2023-24**

| Sem | Course Code | Course Title | Course Category | Offered by | Teaching Scheme | | | | | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Contact Hours | | | | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | | Theory | Practical | Tutorial | Total | | CE | ESE | CE | ESE | CE | ESE | |
| 5 | SECH3211 | Mass Transfer Operations-II | Major/Core | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH3220 | Instrumentation & Process Control | Major/Core | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH3231 | Chemical Engineering Thermodynamics-II | Major/Core | CH | 2 | 0 | 2 | 4 | 4 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SECH3240 | Fuels and Combustion | Major/Core | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3250 | Cleaner Technologies in Chemical Process Industries | Major/Core | CH | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | | **Elective -I** | Minor | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | | Language Training Elective Course | AEC | CFLS | 3 | 0 | 0 | 3 | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | Life Skill Elective Course-I | VAC | CLSC | 2 | 0 | 0 | 2 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | SECH3920 | Summer Training | Minor | CH | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 100 | 0 | 0 | 0 | 100 |
| | | | | | | | **Total** | **27** | **29** | | | | | | | **1200** |
| 6 | SECH3260 | Chemical Reaction Kinetics-I | Major/Core | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH3270 | Process Equipment Design and Drawing | Major/Core | CH | 2 | 0 | 2 | 4 | 4 | 40 | 60 | 0 | 0 | 100 | 0 | 200 |
| | SECH3280 | Petroleum Studies | Major/Core | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH3290 | Process Plant Safety Health and Hygiene | Major/Core | CH | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | | **Elective -II** | Minor | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | TNPC3010 | Corporate Grooming & Etiquette | SEC | TNPC | 3 | 0 | 0 | 3 | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | SECH3490 | MOOC Course / University Elective | SEC | | 3 | 0 | 0 | 3 | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | Life Skill Elective Course-II | VAC | CLSC | 2 | 0 | 0 | 2 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | | | | | | **Total** | **27** | **25** | | | | | | | **1100** |

| Elective Courses | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Offered from Sem. | Course Code | Course Name | Offered By | Teaching Scheme | | | | Credit | Examination Scheme | | | | | | Total |
| | | | | Contact Hours | | | | | Theory | | Practical | | Tutorial | | |
| | | | | Theory | Practical | Tutorial | Total | | CE | ESE | CE | ESE | CE | ESE | |
| 5 | SECH3610 | Corrosion and Electrochemical Engineering | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3620 | Sustainability, Green Chemistry and Engineering | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3630 | Waste to Energy Conversation | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3640 | Polymer Engineering | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| 6 | SECH3650 | Design of Experiments | CH | 2 | 2 | 0 | 4 | 3 | 40 | 60 | 20 | 30 | 0 | 0 | 100 |
| | SECH3660 | Chemical Engineering Plant Design and Economics | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3670 | New Separation Techniques | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3680 | Chemical Process Development and Design | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3211
Course Name: Mass Transfer Operations - II
Prerequisite Course(s): SECH2080-Mass Transfer operations -I

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | -- | 04 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- gain knowledge of basic fundamentals of mass transfer operations such as distillation, equilibrium concept, Adsorption, Absorption etc.
- gain knowledge of fundamental principles, design aspects, equations, associated problems, industrial applications of all-important unit operations such as adsorption, distillation, Leaching etc.
- equip them with the essential knowledge and skills required to appear in campus interview or work as an engineer in the chemical industries with confidence.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Distillation**<br>VLE data, Flash, differential and continuous distillation, McCabe-Thiele and Ponchon-Savarit method, Distillation in a packed column, Azeotropic, extractive, molecular and multicomponent distillation, Reactive distillation. | 07 | 15 |
| 2. | **Absorption**<br>Equilibrium, Material balance for single component transfer, Multi-stage and packed tower operation (Equilibrium approach and rate approach), Graphical and analytical method for tray/ stage determination, Multi-component system, Non-isothermal operation, Absorption with chemical reaction. | 07 | 15 |
| 3. | **Equipment for Gas-Liquid Operations**<br>Sparged and agitated vessels, Venture scrubber, Wetted wall towers, Tray and packed towers, Mass transfer coefficients for packed towers, Hydrodynamic considerations. | 04 | 10 |
| 4. | **Liquid - Liquid Extraction**<br>Liquid equilibria, Stage-wise extraction, Graphical and analytical method for tray/ stage determination, Stage type extractor, Differential extractor | 06 | 15 |
| **Section II** | | | |

| | | | |
|---|---|---|---|
| 5. | **Adsorption and Ion Exchange**<br>Adsorption equilibria, Stage-wise and continuous operations, Graphical and analytical method for tray/ stage determination, Principle of ion exchange, Equipments for adsorption and ion exchange. | 07 | 15 |
| 6. | **Drying**<br>Equilibrium, Batch and continuous drying, Mechanism and rate of drying, Equipments | 06 | 15 |
| 7. | **Leaching**<br>Steady state and unsteady state operations, Methods of calculation, Equipments. | 05 | 10 |
| 8. | **Crystallization**<br>Equilibrium, Operations and equipment. | 03 | 05 |
| | **TOTAL** | **45** | **100** |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Vapor-Liquid Equilibrium | 04 |
| 2. | Simple Batch Distillation unit | 04 |
| 3. | Ternary Diagram | 04 |
| 4. | Liquid-liquid Extraction | 04 |
| 5. | Adsorption in packed bed | 04 |
| 6. | Fluidized Bed dryer | 04 |
| 7. | Leaching | 04 |
| 8. | Crystallization | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Mass Transfer operation | R.E. Treybal | Mc-Graw Hill International Editions |
| Mass Transfer | Sherwood, Pigford & Wilke | Mc-Graw Hill International Editions |
| Mass Transfer –II | K.A. Gavhane | Nirali Prakashan |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Perrys Chemical Engineers Handbook | Perry & Green | Mc-Graw Hill International Editions |
| Chemical Engineering | Coulson, J.M., Richardson, J.F. | Pergamon and ECBS, 1970 |
| Unit operations of Chemical Engg. | W.L. McCabe, J.C. Smith & Harriott | Mc-Graw Hill International Editions |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103103032/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| **SECH3211** | **MASS TRANSFER OPERATIONS - II** |
|---|---|
| CO 1 | Apply vapor-liquid equilibrium principles to analyze and design distillation and absorption operations. |
| CO 2 | Analyze the performance of gas-liquid contacting equipment used in mass transfer operations. |
| CO 3 | Evaluate liquid-liquid extraction, adsorption, and ion-exchange processes for separation applications. |
| CO 4 | Apply mass transfer concepts to drying and leaching operations. |
| CO 5 | Select suitable equipment and operating conditions for crystallization and other mass transfer processes. |

**Mapping of CO with PO**

| **SECH3211** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 1 | 1 | 1 | | | | | | | 1 |
| CO 2 | 2 | 2 | 1 | 2 | 1 | | | | | | | 1 |
| CO 3 | 2 | 2 | 1 | 2 | 1 | | | | | | | 1 |
| CO 4 | 2 | 2 | 1 | 1 | 1 | | | | | | | 1 |
| CO 5 | 2 | 2 | 2 | 1 | 1 | | 1 | | | | | 1 |

**Mapping of CO with PSO**

| **SECH3211** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 2 | 1 | |
| CO 2 | 2 | 1 | 1 |
| CO 3 | 2 | 1 | 1 |
| CO 4 | 2 | 1 | |
| CO 5 | 1 | 2 | 2 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Distillation | 3 |
| 2 | Absorption | 3 |
| 3 | Equipment for Gas-Liquid Operations | 4 |
| 4 | Liquid-Liquid Extraction | 4 |
| 5 | Adsorption and Ion Exchange | 4 |
| 6 | Drying | 3 |
| 7 | Leaching | 3 |
| 8 | Crystallization | 2 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

**Course Code:** SECH3220
**Course Name:** Instrumentation & Process Control Prerequisite
Course (/s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | -- | 04 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand basics of process control and the instrumentation.
- understand topics of automatic process control which is being used in almost all the industries.
- understand modeling of static and dynamic behavior of processes, control strategies, design of feedback, feed forward and other control structures and applications to process equipment.
- elaborate the study of valve characteristics along with the working principle, specifications, and design and selection aspects of various measuring sensors.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module | Content | Hours | Weightage in % |
| 1. | **Introduction to process control**<br>Process control system, Variable physical element of process control system, Modelling of a process. | 04 | 05 |
| 2. | **Laplace Transforms**<br>Properties of Laplace transforms, Solution of linear differential equation using Laplace transform techniques, Dynamic behaviour of systems, Transfer functions | 04 | 10 |
| 3. | **Dynamic behaviour of chemical processes**<br>Analysis of first order system with different forcing functions, Analysis of second & higher order system, Components of feedback control system. | 06 | 20 |
| 4. | **Modes of control action**<br>Controllers and final control elements, closed loop transfer function and block diagram algebra, characteristic equation. | 06 | 15 |
| **Section II** | | | |
| Module | Content | Hours | Weightage in % |

| | | | |
|---|---|---|---|
| 5. | **Stability Criterion**<br>Stability of control systems, controller tuning, Frequency Response Analysis, bode diagrams, Bode diagrams for first & second order systems, P, PI, PID controllers, transportation lag, Nyquist plot, phase margin & gain margin, Nyquist stability criteria. | 04 | 15 |
| 6. | **Piping & Instrumentation (P&I) diagram**<br>Symbols, P&I Diagram of reactors, Distillation column, Shell & tube heat exchanger etc. | 03 | 10 |
| 7. | **Introduction of Process Measurement**<br>Elements of instruments, Parts of instruments, Static and dynamic characteristics. | 04 | 10 |
| 8. | **Measuring devices for flow, temperature, pressure and level.** | 04 | 15 |
| | **TOTAL** | **45** | **100** |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction to Instrumentation & Control Laboratory | 02 |
| 2. | Calibration of pressure gauge | 04 |
| 3. | Dynamics of thermometer | 04 |
| 4. | Dynamics of thermal system | 04 |
| 5. | Dynamics of evacuation system | 04 |
| 6. | Dynamics of liquid level system | 04 |
| 7. | Control of liquid level system | 04 |
| 8. | Dynamics & control of heat exchanger | 04 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Process Control | Stephanopoulos | Prentice Hall of India |
| Industrial Instrumentation | Donald .P. Eckman | John Wiley & Sons Inc, New York |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Process System Analysis & Control | Coughanower and Kappel | Mc-Graw Hill International |
| Process dynamics and control | Seborg, D.E.,Edgar, T.F. | Wiley, NewYork |
| Process Instrumentation And Control | A. P. Kulkarni | Nirali Prakashan |
| Industrial Instrumentation & Control | S. K. Singh | Tata McGraw-Hill Education. |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103105064/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests of 30 marks each and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty Evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consist of performance of Practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 mark.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| **SECH3220** | **INSTRUMENTATION & PROCESS CONTROL** |
|---|---|
| CO 1 | Summarize information about common instruments on the chemical process systems as well as the operating principles. |
| CO 2 | Develop conceptual understanding of the mathematical modelling and transfer functions of open loop control systems to study their responses. |
| CO 3 | Analyze how to develop closed loop block diagram. |
| CO 4 | Explain the use of block diagram and the mathematical basis for the design of control systems. |
| CO 5 | Measure steadiness of the control system with time and frequency domain analysis techniques. |

**Mapping of CO with PO**

| **SECH3220** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | | 2 | | | | 2 | | 1 | | 2 |
| CO 2 | | 1 | | | | 1 | | | | | | |
| CO 3 | | | 2 | 1 | 2 | | 1 | | | 1 | 1 | |
| CO 4 | | | | | 1 | | | | | | | |
| CO 5 | 3 | 2 | | 1 | 1 | | | | 1 | | 3 | 2 |

**Mapping of CO with PSO**

| **SECH3220** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | 1 |
| CO 2 | 2 | 1 | 2 |
| CO 3 | 1 | | 1 |
| CO 4 | | 1 | |
| CO 5 | 1 | 3 | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction to process control | 1,2 |
| 2 | Laplas Transforms | 1,2,5 |
| 3 | Dynamic behavior of chemical processes | 1,5 |
| 4 | Modes of control action | 1,2 |
| 5 | Stability Criterion | 1,2,5 |
| 6 | Piping & Instrumentation (P&I) diagram | 1,4 |
| 7 | Introduction of Process Measurement | 1,2 |
| 8 | Measuring devices for flow, temperature, pressure and level. | 1,2 |

**P P Savani University**
**School of Engineering**

## Department of Chemical Engineering

Course Code: SECH3231
Course Name: Chemical Engineering Thermodynamics-II
Pre-requisite Course: SESH2070- Chemical Engineering Thermodynamics-I

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | 02 | 04 | 40 | 60 | -- | -- | 100 | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand and appreciate thermodynamics as applied to various Chemical Engineering Processes.
- avail practical experience on the principles, viz., thermodynamic laws, Solution thermodynamics, Phase equilibrium and reaction equilibrium.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Thermodynamic Properties of Pure Substances** fugacity, fugacity coefficient, compressibility factor, activity. | 07 | 10 |
| 2. | **Gibbs-Duhem Equation** General form, Various forms of Gibbs-Duhem equation, Applications, Limitations, Property changes of mixing, Excess Properties. | 07 | 15 |
| 3. | **Activity Coefficient** Equations used for the determination, Margules, Van Laar, Wilson equations, VLE at high pressures, Bubble Point, Dew Point Calculations, Thermodynamic Consistency Tests for VLE data. | 08 | 15 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 4. | **Liquid Phase Properties** Liquid-Phase Properties from VLE Data ,Composition Dependence of Liquid- Phase Fugacities for Species in a Binary Solution, Excess Gibbs Energy, Data Reduction, Thermodynamic Consistency, Integral or Area Test Method , Models for the Excess Gibbs Energy, Margules Equations, Van Laar Equations, Calculations with Margules and Van Laar Equations, Local Composition Models, NRTL Equation, UNIQUAC Equation, UNIFAC | 08 | 12 |

| | | | |
|---|---|---|---|
| | Method, Enthalpy/ Concentration Diagrams. | | |
| 5. | **Chemical Reaction Equilibrium**<br>Criteria of equilibrium, Reaction stoichiometry, equilibrium constant, Gibbs free energy change, Choice of standard state, Feasibility of Chemical reactions, Effect of temperature on Equilibrium Constant, Evaluation of van't Hoff Constant, Effect of parameters like temperature, pressure, composition on the equilibrium conversion. | 08 | 15 |
| 6. | **Phase Equilibria**<br>The Gamma / Phi Formulation of VLE, Equilibrium and stability, Liquid-liquid equilibrium, Solid- Liquid Equilibrium, Osmotic Equilibrium and Osmotic pressure. | 07 | 5 |
| | **TOTAL** | **45** | **100** |

**List of Tutorials:**

| Sr. No | Name of Tutorial | Hours |
|---|---|---|
| 1. | Problem related to Thermodynamic properties of fluids | 04 |
| 2. | Problem related to Thermodynamic properties of fluids | 04 |
| 3. | Problem related to Phase equilibrium | 04 |
| 4. | Problem related to Phase equilibrium | 04 |
| 5. | Problem related to Phase equilibrium | 04 |
| 6. | Problem related to CHEMICAL EQUILIBRIUM | 04 |
| 7. | Problem related to CHEMICAL EQUILIBRIUM | 04 |
| 8. | Problem related to CHEMICAL EQUILIBRIUM | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Introduction to Engineering Thermodynamics | J.M. Smith, Hendrick Van Ness, Michael M. Abbott, | McGraw Hill, New York, 2005. |
| Chemical Engineering Thermodynamics | S. Sundaram | Ahuja Publishers, New Delhi, 2001 |
| A Textbook of Chemical Engineering Thermodynamics | K.V. Narayanan | PHI Learning, 2004 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering Thermodynamics | B.F. Dodge | McGraw Hill, New York, 1971 |
| Chemical Engineering Thermodynamics | Y.V.C. Rao | Universities Press (1997) |
| Chemical Process Thermodynamics 3rd Ed | B.G. Kyle | Prentice Hall India, 1994 |
| Chemical Process Principles Part II | Hougen, O.A., Watson, K.M. and Ragatz, R.A. | John Wiley & Sons, (CBS Publishers & Distributors, New Delhi) |

**Course Evaluation:**
**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Tutorial:**

- Continuous Evaluation consists of performance of Tutorials which will be evaluated out of 10 marks for each Tutorial and average of the same will be converted to 30 marks.
- MCQ based examination consists of 10 marks.
- Internal Viva consists of 10 marks.

**Course Outcome(s):**

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

| **SECH3231** | **CHEMICAL ENGINEERING THERMODYNAMICS-II** |
|---|---|
| CO 1 | Coorelate the conditions of equilibrium for multiphase systems. |
| CO 2 | Apply thermodynamic principles to understand fugacity, partial molar properties, chemical potential, and |
| CO 3 | Comprehend knowledge of vapor pressure for single component multiphase systems. |
| CO 4 | Anlayze models for excess gibbs free energy in non ideal mixtures. |
| CO 5 | Perform calculations for vapor liquid equilibrium system. |

**Mapping of CO with PO**

| **SECH3231** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | 2 | | | | 2 | | 1 | 1 | | |
| CO 2 | 2 | 2 | | 3 | 2 | | | 1 | 1 | | | 2 |
| CO 3 | 1 | | 1 | | 1 | 1 | | | 1 | | 1 | |
| CO 4 | | 1 | 1 | | | | 2 | | | | | 3 |
| CO 5 | 1 | 2 | 1 | | 1 | | | 3 | 2 | | | |

**Mapping of CO with PSO**

| **SECH3231** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | 1 | 1 |
| CO 2 | | | 2 |
| CO 3 | | 3 | 1 |
| CO 4 | 3 | 3 | |
| CO 5 | | | 2 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Thermodynamic Properties of Pure Substances | 1,2 |
| 2 | Gibbs-Duhem Equation | 2,3 |
| 3 | Activity Coefficient | 1,4 |
| 4 | Liquid Phase Properties | 2,4 |
| 5 | Chemical Reaction Equilibrium | 2,3,6 |
| 6 | Phase Equilibria | 5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3920
Course Name: Summer Training
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| - | - | - | 04 | -- | -- | 100 | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- have first-hand experience the real time situations in industrial scenario.
- get familiar with engineering applications in industrial spectrum
- learn to adapt themselves in professional scenario

**Outline of the Course:**

| Sr. No | Content |
|---|---|
| 1. | Selection of Companies |
| 2. | Company Information collection |
| 3. | Report Writing |
| 4. | Presentation & Question-Answer |

**Course Evaluation:**

| Sr. No. | Evaluation criteria | Marks |
|---|---|---|
| 1 | Actual work carried & Report Submission | 50 |
| 2 | Final Presentation & Question-Answer session | 50 |
| **TOTAL** | | **100** |

**Report Writing Guidelines**

**A. Report Format:**

1. Title Page (to be provided by the respective supervisor)

The title page of the project shall give the following information in the order listed:

- Full title of the project as approved by the Mentor;
- The full name of the student/Group of students with enrollment number;
- The qualification for which the project is submitted;
- The name of the institution to which the project is submitted;
- The month and year of submission.

2. Project Certification Form
   [The form should be duly filled signed by the supervisors.]
3. Acknowledgements
   [All persons (e.g. supervisor, technician, friends, and relatives) and organization/authorities who/which have helped in the preparation of the report shall be acknowledged.]
4. Table of Contents/Index with page numbering
5. List of Tables, Figures, Schemes
6. Summary/abstract of the report.

7. Introduction/Objectives of the identified problem
8. Data Analysis and Finding of Solution
9. Application of the identified solution
10. Future Scope of enhancement of the Project and Conclusion
11. "Learning during Project Work", i.e. "Experience of Journey during Project Duration"
12. References(must)
13. Bibliography
14. Annexures (if any)

**B. Guideline for Report Formatting:**

- Use A4 size page with 1" margin all sides
- Header should include Project title and footer should contain page number and enrollment numbers
- Chapter Name should be of Cambria font, 20 points, Bold
- Main Heading should be of Cambria font, 14 points, Bold
- Sub Heading should be of Cambria font, 12 points, Bold
- Sub Heading of sub heading should be of Cambria font, 12 points, Bold, Italic
- Paragraph should be of Cambria font, 12 points, no margin at the start of the paragraph
- Line spacing for all content – 1.15, before - 0, after - 0
- No chapter number for references
- Before chapter 1, give page numbers in roman letter

**Course Outcome(s):**

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

| **SECH3920** | **SUMMER TRAINING** |
|---|---|
| CO 1 | Construct company profile by compiling brief history, management structure, products/services offered, key achievements and market performance for the company visited during internship. |
| CO 2 | Determine the challenges and future potential for his/her internship organization in particular and the sector in general. |
| CO 3 | Test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period. |
| CO 4 | Apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship organization. |
| CO 5 | Analyze the functioning of internship organization and recommend changes for improvement in processes. |

**Mapping of CO with PO**

| **SECH3920** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | 1 | 2 | | | | | | | | 2 |
| CO 2 | 1 | 3 | 1 | 1 | | 3 | | | | 1 | 2 | 1 |
| CO 3 | 1 | | | 2 | 3 | 3 | 2 | | 1 | | 2 | 1 |
| CO 4 | 1 | | | 1 | 3 | 3 | 1 | | 1 | 2 | 2 | 1 |
| CO 5 | 1 | | | 2 | | 3 | 3 | | | | | 1 |

**Mapping of CO with PSO**

| **SECH3920** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | 2 | |
| CO 2 | 3 | 2 | 2 |
| CO 3 | 3 | 2 | |
| CO 4 | 3 | 2 | 2 |
| CO 5 | 3 | 3 | 2 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Selection of Companies | 1,2,3,4 |
| 2 | Company Information collection | 1,2,3,4 |
| 3 | Report Writing | 1,2,3,4 |
| 4 | Presentation & Question-Answer | 1,2,3,4 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3240
Course Name: Fuels and Combustion
Prerequisite Course: - Nil

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | -- | -- | 03 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objectives of the Course:**
To help learners to

- Understand Fuel Properties and Classification
- Apply Combustion Chemistry Principles
- Assess Combustion Technologies
- Evaluate Environmental Impact and Mitigation

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Fuels**<br>Classification, Properties, Calorific Value, Proximate & Ultimate Analysis of Coal. | 02 | 15 |
| 2. | **Solid Fuels**<br>Coal: Types, Carbonization, Biomass Fuels, Coke Manufacturing. | 06 | 15 |
| 3. | **Liquid Fuels**<br>Petroleum Refining, Cracking, Reforming, Synthetic Fuels | 08 | 15 |
| 4. | **Gaseous Fuels**<br>Natural Gas, LPG, Producer Gas, Water Gas, Biogas. | 04 | 15 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 5. | **Combustion Chemistry**<br>Stoichiometry, Heat of Combustion, Air-Fuel Ratio. | 06 | 10 |
| 6. | **Combustion Technologies**<br>Types of Flames, Burners, Furnaces, Ignition Phenomena. | 05 | 10 |

| | | | |
|---|---|---|---|
| 7. | Environmental Pollution from Combustion<br>Emissions (CO, NOx, SOx, Particulates), Pollution Control Strategies | 06 | 10 |
| 8. | Alternative Fuels and Energy Efficiency<br>Biodiesel, Hydrogen, Fuel Cells, Energy Conservation Techniques | 08 | 10 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| **Title** | **Author/s** | **Publication** |
|---|---|---|
| Process Plant layout and Piping Design | Roger Hunt and Ed Bausbacher | PTR Prentice-Hall Inc |
| Process utility systems | Jack Broughton | Institution of Chem. Engineers, U.K. |

**Reference Book(s):**

| | | |
|---|---|---|
| Chemical Engineering Plant Design | F.C. Vibrandt and C.E. Dryden | McGraw Hill, Fifth Edition |
| Plant design and Economics for Chemical Engineers | M.S. Peters and Timmerhaus | Mc Graw Hill 3rd Edition |

**Web Material Link(s):**

- https://nptel.ac.in/syllabus/105102089/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

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

| **SECH3240** | **Fuels and Combustion** |
|---|---|
| CO 1 | Understand the classification and properties of various fuels. |
| CO 2 | Analyze combustion reactions and energy efficiency. |
| CO 3 | Assess the environmental effects of fuel combustion. |
| CO 4 | Learn techniques for emission control and energy conservation. |

**Mapping of CO with PO**

| **SECH3240** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 2 | 1 | | | 1 | 2 | | 2 | 2 | | |
| CO 2 | | | 1 | 2 | 1 | | | | | 3 | | |
| CO 3 | 2 | | 1 | | | | 2 | 1 | | 3 | 1 | 1 |
| CO 4 | | 2 | | 2 | 3 | | | | | | 1 | 1 |

**Mapping of CO with PSO**

| SECH3240 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | 2 | 3 |
| CO 2 | 3 | 1 | 2 |
| CO 3 | 3 | 2 | |
| CO 4 | 3 | | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction to Fuels and Their Properties | 1,2,3,4 |
| 2 | Solid Fuels: Coal, Biomass, and Coke | 1,2,3,4,5,6 |
| 3 | Liquid Fuels: Petroleum, Cracking, and Reforming | 1,2,3,4 |
| 4 | Gaseous Fuels: Natural Gas, LPG, and Biogas | 1,2,3,4 |
| 5 | Combustion Chemistry and Stoichiometry | 1,2,3,4 |
| 6 | Combustion Technologies: Burners and Furnaces | 1,3,4,5 |
| 7 | Environmental Pollution from Fuel Combustion | 1,2,3,4,5 |
| 8 | Alternative Fuels and Energy Efficiency | 1,2,4 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3250
Course Name: Cleaner Technologies in Chemical Process Industries
Prerequisite Course: - Nil

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | -- | 02 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objectives of the Course:**
To help learners to

- Understand Principles of Cleaner Production
- Apply Process Optimization Strategies
- Analyze Pollution Control Technologies
- Evaluate Regulatory Compliance and Case Studies

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Cleaner Production**<br>Principles of Cleaner Production, Sustainable Development, Circular Economy, Life Cycle Assessment. | 05 | 15 |
| 2. | **Green Chemistry and Process Optimization**<br>Principles of Green Chemistry, Catalysis, Solvent Selection, Energy Efficiency, Process Intensification, Sustainable Manufacturing. | 05 | 20 |
| 3. | **Waste Minimization Strategies**<br>Source Reduction, Recycling, By-product Utilization. | 05 | 15 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 4. | **Pollution Control Technologies**<br>Adsorption, Membrane Separation, Advanced Oxidation Processes, Zero Liquid Discharge (ZLD) Systems. | 05 | 20 |
| 5. | **Water Management and Environmental Compliance**<br>Effluent Treatment, Reverse Osmosis, Environmental Laws, EIA, Industry Standards (ISO 14000, EPA). | 05 | 20 |
| 6. | **Industrial Case Studies:**<br>Cleaner Technologies in Petrochemical, Pharmaceutical, Textile, and Agrochemical Industries. | 05 | 10 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Process Plant layout and Piping Design | Roger Hunt and Ed Bausbacher | PTR Prentice-Hall Inc |
| Process utility systems | Jack Broughton | Institution of Chem. Engineers, U.K. |

**Reference Book(s):**

| | | |
|---|---|---|
| Chemical Engineering Plant Design | F.C. Vibrandt and C.E. Dryden | McGraw Hill, Fifth Edition |
| Plant design and Economics for Chemical Engineers | M.S. Peters and Timmerhaus | Mc Graw Hill 3rd Edition |

**Web Material Link(s):**

- https://nptel.ac.in/syllabus/105102089/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

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

| SECH3250 | CLEANER TECHNOLOGIES IN CHEMICAL PROCESS INDUSTRIES |
|---|---|
| CO 1 | Understand the principles of cleaner production and sustainable development. |
| CO 2 | Apply green chemistry and waste minimization techniques. |
| CO 3 | Analyze pollution control strategies in industries. |
| CO 4 | Learn energy-efficient and eco-friendly process designs. |

**Mapping of CO with PO**

| SECH3250 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | | 1 | | | | | | | | |
| CO 2 | 1 | 1 | 1 | | | 2 | | | | | | |
| CO 3 | | 1 | 1 | | 1 | 3 | 2 | 1 | | 2 | | 2 |
| CO 4 | | 1 | 1 | | | | | 3 | 2 | 2 | | |

**Mapping of CO with PSO**

| SECH3250 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | | |
| CO 2 | | | 2 |
| CO 3 | 1 | | 3 |
| CO 4 | 1 | | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction to Cleaner Production and Sustainability | 1,4 |
| 2 | Green Chemistry and Eco-friendly Solvents | 2,5 |
| 3 | Process Optimization and Energy Efficiency | 2,4 |
| 4 | Waste Minimization and Resource Recovery | 2,4,5,6 |
| 5 | Advanced Pollution Control Technologies | 2,4,5,6 |
| 6 | Zero Liquid Discharge (ZLD) and Water Management | 2,4,5 |
| 7 | Environmental Regulations and Compliance | 6 |
| 8 | Industrial Case Studies on Cleaner Technologies | 4,6 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3260
Course Name: Chemical Reaction Kinetics - I
Prerequisite Course(s): SECH2010 – Chemical Process Calculations
SESH1220 – Chemistry

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | -- | 04 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand the basic principles of kinetics and chemical reaction engineering by the application of Stoichiometry, thermodynamics and mathematical analysis.
- utilize this knowledge in the design of industrial chemical reactors.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Fundamentals of Reaction Engineering**<br>Overview of chemical reaction engineering, Rate of Reaction, Elementary and non-elementary homogeneous reactions, Molecularity and order of reaction, Mechanism of reaction, Temperature dependency from thermodynamics, Collision and Activated complex theories. | 07 | 10 |
| 2. | **Rate Laws, Kinetics and Mechanisms of Homogeneous and Heterogeneous Reactions**<br>Kinetic models for non-elementary reactions, Testing kinetic models, Temperature dependent term of rate equations from Arrhenius theory and comparison with collision and transition state theory, Activation energy and temperature dependency, Predictability of reaction rate from theory. | 08 | 10 |
| 3. | **Analysis of Rate Data**<br>Integral and differential methods for analyzing kinetic data, interpretation of constant volume reactor, zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, catalytic reaction, auto catalytic reaction, reversible reactions. | 08 | 10 |

| | | | |
|---|---|---|---|
| 4. | **Introduction to Reactor Design**<br>Interpretation of variable volume batch reactions for zero, first and second order reactions, design equation for batch, continuous stirred tank, plug flow reactors for isothermal reaction. | 07 | 20 |
| | **Section II** | | |
| Module | Content | Hours | Weightage in % |
| 5. | **Design of industrial reactors**<br>Optimum reactor size, plug flow/mixed flow reactors in series and parallel, recycle reactor. | 10 | 15 |
| 6. | **Design of reactors for single and parallel reaction**<br>Size comparison of single reactors, multiple reactor systems, recycles reactor and autocatalytic reactions. Introduction to multiple reactions, qualitative and quantitative treatment of product distribution and of reactor size, the selectivity. | 10 | 15 |
| 7. | **Residence time distributions**<br>Residence time distribution of fluids in vessels, E, F and C curves, Dispersion model, Tank in series model. Non- Isothermal PFR and CSTR, Safety issues in Non-Isothermal Reactors. | 10 | 20 |
| | **TOTAL** | **45** | **100** |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1. | To study the interpretation of Batch Reactor Data. | 02 |
| 2. | To determine energy of activation of reaction between ethyl acetate with sodium hydroxide. | 04 |
| 3. | To determine reaction equilibrium constant of reaction of acetic acid with ethanol. | 04 |
| 4. | To measure the kinetics of a reaction between ethyl acetate and sodium hydroxide under condition of excess ethyl acetate at room temperature. | 04 |
| 5. | To determine the kinetics of the reaction between ethyl acetate and sodium hydroxide at room temperature by the integral method of analysis. | 04 |
| 6. | To determine the kinetics of the reaction between ethyl acetate and sodium hydroxide at room temperature by the differential method of analysis. | 04 |
| 7. | To determine reaction equilibrium constant of reaction between acetic acid with ethanol. | 04 |
| 8. | To study the kinetics of saponification reaction between acetic acid and sodium hydroxide in a batch reactor and establish the rate law. | 04 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering Kinetics - 3rd Edition | J. M. Smith | McGraw-Hill (1990) |
| Chemical Reaction Engineering - 3rd Edition | O. Levenspiel | John Wiley (1998) |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Elements of Chemical Reaction Engineering | H. Scott Fogler | Prentice Hall of India Pvt. Ltd |
| The Engineering of Chemical Reactions | L. D. Schmidt | Oxford Press |

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| SECH3260 | CHEMICAL REACTION KINETICS-I |
|---|---|
| CO 1 | Classify the concept of reactor design for chemical process industries. |
| CO 2 | Analyze kinetics and rate law based on experimental data obtained from the laboratory. |
| CO 3 | Perform calculations on plug, mixed, and batch reactors for homogeneous and heterogeneous reactions. |
| CO 4 | Develop skills to choose, design and scale the right kind of reactor for a given reaction. |

**Mapping of CO with PO**

| SECH3260 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 2 | 2 | | 1 | 2 | | | 1 | 3 | | | 1 | |
| CO 3 | 1 | 2 | | | 1 | | 1 | | 1 | 1 | 1 | 2 |
| CO 4 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | | | 1 | 1 | |

**Mapping of CO with PSO**

| SECH3260 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 2 | 3 | 3 |
| CO 2 | 1 | 3 | 2 |
| CO 3 | | | 3 |
| CO 4 | 2 | 3 | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Fundamentals of Reaction Engineering | 2,3 |
| 2 | Rate Laws, Kinetics and Mechanisms of Homogeneous and Heterogeneous Reactions | 2,3,5 |
| 3 | Analysis of Rate Data | 4,5,6 |
| 4 | Introduction to Reactor Design | 1,2,4 |
| 5 | Design of industrial reactors | 2,5,6 |
| 6 | Design of reactors for single and parallel reaction | 5,6 |
| 7 | Residence time distributions | 1,2,4,6 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3270
Course Name: Process Equipment Design and drawing
Prerequisite Course(s): SECH3010 – Heat Transfer Operations
SECH3021 – Mass Transfer operations - II

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | 02 | -- | 04 | 40 | 60 | 40 | 60 | 100 | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand modifications and additions to existing plants or creating design layouts of plant / Equipment.
- rapidly increase rate in the advancement of knowledge and relevant application for equipment design.
- observe conclusively the practices in using the reference literature and software.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Basic Consideration in Process Equipment Design**<br>Introduction to Computer Aided Design of Equipment and Process Flow Sheeting, General Design Procedure, Materials of Construction and Design Considerations, Pressure Vessels - Classification, Applications and Design Considerations (Factors influencing the Design of Vessels, Design Pressure, Design Temperature, Factor Safety and Welding Joint Efficiency) - Numerical Problem on Design of Pressure Vessel Subjected to Internal Pressure. | 08 | 20 |
| 2. | **Enclosures, Flanges, Nozzles and Supports**<br>Various Types of Enclosures (Heads or Cover) used for the Pressure Vessels - Classifications of Enclosures and their Applications - Numerical Problem on Various Types of Enclosures, Types of Flanges, Nozzles and Supports used for Pressure Vessel - Selection Criteria for Flanges, Nozzles and Supports, Numerical Problem on Flanges, Nozzles and Supports. | 08 | 20 |
| 3. | **Reaction/Agitated Vessels, Basket Centrifuge, Gravity Thickener and Cyclone Separator**<br>Introduction, Classification and Design Consideration of Reaction Vessel - Numerical Problem on the Design of Reaction/Agitated Vessel, Theory and Numerical problem on the Design of Basket Centrifuge, Gravity Thickener and Cyclone Separator. | 07 | 10 |
| **Section II** | | | |
| **Module** | **Content** | **Hours** | **Weightage** |

| No. | | | in % |
|---|---|---|---|
| 4. | **Heat Exchangers, Evaporators and Crystallizers**<br>Introduction –Types of Heat Exchangers and Numerical Problem on Design of Shell and Tube Heat Exchanger, Theory of Evaporators and Numerical Problem on Design of Single Effect Evaporator, Theory of Crystallizers and Numerical Problem on the Design of Crystallizers. | 10 | 25 |
| 5. | **Distillation Column, Absorption Column and Rotary Drier**<br>Theory and Design Aspects of Distillation Column - Numerical Problem on the Design of Distillation for Binary System, Theory and Design Aspects of Absorption Column, Numerical Problem on the Design of Absorption Column, Theory and Design Aspects of Rotary Drier, Numerical Problem on the Design of Rotary Drier. | 12 | 25 |
| | **TOTAL** | **30** | **100** |

**Drawing of Process Equipment:**

| Sr. No | Process Equipment | Hours |
|---|---|---|
| 1. | Flow sheeting, pressure vessel, and enclosures | 02 |
| 2. | Flanges, nozzles and supports | 04 |
| 3. | Agitated vessel and basket centrifuge | 04 |
| 4. | Gravity thickener | 02 |
| 5. | Cyclone separator | 02 |
| 6. | Heat exchangers | 04 |
| 7. | Evaporators | 02 |
| 8. | Crystallizer | 04 |
| 9. | Distillation and absorber column | 04 |
| 10. | Rotary dryer | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering - Volume 6, 3rdEdn | Sinnott. R.K, Coulson & Richardson's | Butterworth Heinemann, New Delhi, 1999 |
| Chemical Engineers Handbook - Perry's, 7th Edn | Perry. R.H., et al. | McGraw Hill, NewYork, 1997 |
| Process Equipment Design | Bownell, L.E., and Young, E.M | Wiley Eastern, 1968 |
| Introduction to Process Engineering and Design | S B Thakore and B I Bhatt | Tata McGraw Hill, 1st Edition, 2007 |
| Process Equipment Design | Joshi. M.V. and Mahajani. V.V | Macmillan India Limited, New Delhi, 1996 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Process Equipment: Design and Drawing (Vol. I) | Maidargi, Suresh C. | Prentice Hall India, 2015 |
| Introduction to Chemical Equipment Design: Mechanical Aspects | Bhattacharyy, B C. | CBS Publisher, 2012 |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103103027/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Tutorial:**

- Continuous Evaluation consists of performance of tutorial which will be evaluated out of 10 marks for each tutorial and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| **SECH3270** | **PROCESS EQUIPMENT DESIGN AND DRAWING** |
|---|---|
| CO 1 | Classify different process equipments used in chemical process industry. |
| CO 2 | Differentiate different supports used in process industries and apply strategies in selection of supports. |
| CO 3 | Design special vessels and various parts of vessels. |
| CO 4 | Design different kinds of heat exchanger and evaporator. |
| CO 5 | Demonstrate procedures in designing of tray distillation columns including minimum reflux ratio, number of stages, feed stage, and column diameter. |

**Mapping of CO with PO**

| **SECH3270** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 2 | 1 | | | | | 2 | 2 | | 3 |
| CO 2 | 2 | 2 | 2 | 3 | | | | | 2 | 3 | | 2 |
| CO 3 | 2 | 1 | 3 | 2 | | | | | 3 | 2 | | 1 |
| CO 4 | 3 | 3 | 3 | 1 | | | | | 3 | 3 | | 2 |
| CO 5 | 2 | 3 | 3 | 3 | | | | | 3 | 3 | | 3 |

**Mapping of CO with PSO**

| **SECH3270** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 2 | 1 | 2 |
| CO 2 | 3 | 3 | 3 |
| CO 3 | 3 | 1 | 2 |
| CO 4 | 2 | 2 | 1 |
| CO 5 | 3 | 2 | 3 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Basic Consideration in Process Equipment Design | 1,2 |
| 2 | Enclosures, Flanges, Nozzles and Supports | 1,2,5,6 |
| 3 | Reaction/Agitated Vessels, Basket Centrifuge, Gravity Thickener and Cyclone Separator | 1,2,5,6 |
| 4 | Heat Exchangers, Evaporators and Crystallizers | 1,2,5,6 |
| 5 | Distillation Column, Absorption Column and Rotary Drier | 1,2,6 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3280
Course Name: Petroleum Studies Prerequisite
Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | -- | 04 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand various chemical allied operations related to petroleum industries.
- know the wide field of chemical engineering in petrochemical.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Basic of Petroleum**<br>Role of Crude oil in global economy, Present Scenario of Crude Oil Refinery, Importance, Occurrence, Origin(formation), Exploration, Composition, Classification and Evaluation of Crude oil, Crude Assay Analysis, Distillation Characteristics such as TBP, ASTM& EFV etc. | 04 | 10 |
| 2. | **Properties of Crude and Petroleum Products**<br>Various types of Average Boiling Points of Crude Oil & Petroleum Fractions, Types of Gases & their Composition, Types of Gasoline & it's Important Properties and tests such as ASTM Distillation, RVP, Octane Number, Oxidation Stability, Sulphur Content etc, Various Types of Naphtha and their Important Properties & Applications. Important Tests & Properties of Kerosene such as Flash& Fire Point, Smoke Point<br>, Aniline Point etc., Types of Diesel & its Important Properties & Tests such as Pour Point, Diesel Index, Cetane Number etc. Heavy Fractions like Lube Oil, Bitumen, Asphalt etc & their Important Properties such as Viscosity Index, Carbon Residue, Penetration Index, Softening Point. | 06 | 10 |
| 3. | **Processing of Petroleum**<br>Pretreatment of Crude (Dehydration & Desalting), Pumping of Waxy Crude, Heating of Crude, Distillation of Petroleum & Types of Reflux, ADU & VDU, Topping Operations etc. | 04 | 10 |

| | | | |
|---|---|---|---|
| 4. | **Treatment Techniques**<br>Physical Impurities found in Crude& their Removal, Sweetening Techniques, Production and Treatment of LPG & their Methods, Dehydration and Sweetening of Gases, Gasoline Treatment such as Lead Doctoring, Merox Sweetening, Catalytic Desulphurization etc. Treatment of kerosene, Various Methods of Treatment of Lubes such as Clay Treatment, Phenol Extraction, Furfural Extraction, Dewaxing. | 04 | 10 |
| 5. | **Thermal & Catalytic Cracking**<br>Necessity and Types of Cracking<br>**Thermal Cracking**<br>Mechanism of Thermal Cracking, Properties of Cracked Materials, Vis Breaking, Dubb's Two Coil Process, Delayed Coking, Naphtha Cracking, etc.<br>**Catalytic Cracking**<br>Advantage & Theory of Catalytic Cracking, Fixed bed, Moving Bed & Fluidized Bed Technology, FCC, Hydrocracking, Catalytic Reforming, Platforming, Continuous Catalyst Regeneration Reforming, Catalytic Polymerization, Catalytic Alkylation, Catalytic Isomerization, etc. | 05 | 10 |
| | **Section II** | | |
| Module No. | Content | Hours | Weightage in % |
| 6. | **Petrochemicals and Petro Industries**<br>Physical & Chemical Properties, Various Routes of Production, Manufacturing Processes, Flow Sheets, Thermodynamics & Kinetics Consideration & Major Engineering Problems for following Petrochemicals. | 05 | 10 |
| 7. | **C1 Petrochemicals**<br>Petrochemicals Obtained from Methanol, Formaldehyde, Chloromethane etc. | 04 | 10 |
| 8. | **C2 Petrochemicals**<br>Petrochemicals obtained from Ethylene, Ethanolamine, Ethylene Dichloride, Vinyl Chloride, Ethylene Oxide etc. | 05 | 10 |
| 9. | **C3 &Aromatic Petrochemicals**<br>Petrochemicals Obtained from Propylene, ACN, Isopropanol, Cunene, BTX Separation, Phenol, Styrene, Phthalic Anhydride etc. | 04 | 10 |
| 10. | **Polymers**<br>PVC, LDPE, LLDPE, HDPE, Polypropylene, Polypropylene Co- polymers, Polystyrene, SBR, Polyesters etc. | 04 | 10 |
| | **TOTAL** | **45** | **100** |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Determination of Aniline point of the given oil sample | 02 |
| 2. | Determination of the flash & fire point of a given sample of oil by Pensky – Martin apparatus | 04 |
| 3. | Determination of distillation characteristics of gasoline using A.S.T.M distillation | 04 |
| 4. | Determination of viscosity of given sample of heavy oil saybolt viscometer | 04 |
| 5. | Determination of viscosity of given sample of heavy oil redwood viscometer | 04 |

| | | |
|---|---|---|
| 6. | Determination of percentage carbon residue of petroleum product by conradson carbon residue. | 04 |
| 7. | Determination of softening point of given bituminous material | 04 |
| 8. | Determination of the flash point of a given sample of oil by Able's apparatus | 04 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Modern Petroleum Refining Processes | B. K. Bhaskar Rao | Oxford and IBH 2007 |
| Dryden's Outlines of Chemical technology, 3rd Edition | M Gopal Rao | East-West press Pvt. Ltd, Delhi |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Petroleum Refinery Engineering | W. L. Nelson | McGraw Hill, Newyork, 1958. |
| The Chemistry and technology of Petroleum | Speight, J. G. | 5th Edition, M. Dekker, 1991 |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103/102/103102022/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10 for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral performance of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| SECH3280 | PETROLEUM STUDIES |
|---|---|
| CO 1 | Identify compositions of crude oil. |
| CO 2 | Illustrate knowledge about preprocessing and basic separation processes of crude oil. |
| CO 3 | Classify different types of methods for enhancement of refinery products. |
| CO 4 | Interpret various purification processes of crude oil. |
| CO 5 | Generalize manufacturing processes & applications of widely used petrochemicals. |

**Mapping of CO with PO**

| SECH3280 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | | | | 1 | 1 | 2 | 1 | | | | 1 | |
| CO 2 | 1 | | | | | | | 1 | | | | |
| CO 3 | 1 | 2 | | | 1 | | 2 | 3 | | | 1 | 2 |
| CO 4 | 1 | 1 | | | | | | | | | 1 | 2 |
| CO 5 | 2 | | 3 | | 1 | | 1 | | 1 | | 1 | 3 |

**Mapping of CO with PSO**

| SECH3280 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | 1 | 2 |
| CO 2 | 2 | 1 | |
| CO 3 | 3 | | 1 |
| CO 4 | | | 1 |
| CO 5 | 1 | 2 | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Basic of Petroleum | 1,2 |
| 2 | Properties of Crude and Petroleum Products | 2,3 |
| 3 | Processing of Petroleum | 3,4,5 |
| 4 | Treatment Techniques | 2,3,4 |
| 5 | Thermal & Catalytic Cracking | 2,5 |
| 6 | Petrochemicals and Petro Industries | 1,2,5 |
| 7 | C1 Petrochemicals | 2,5,6 |
| 8 | C2 Petrochemicals | 2,5,6 |
| 9 | C3 &Aromatic Petrochemicals | 2,5,6 |
| 10 | Polymers | 1,2,5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3290
Course Name: Process Plant Safety Health and Hygiene Prerequisite
Course: - Nil

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | -- | 02 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objectives of the Course:**
To help learners to

- critically understand the importance of safety in process industries.
- assess and identify the potential hazards in process industries.
- identify and evaluate the causes of accident in a chemical industry.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Introduction to Safety in Chemical process Industries**<br>Need for Development of Safety Consciousness in Chemical Industries-Hazard-Risk-Danger-Accident, Promotion of industrial safety, Extreme operating conditions, toxic chemicals, Safe handling, psychological attitude towards safety. | 05 | 15 |
| 2. | **Safety Programs in Industries**<br>Importance of Safety Programs in industries, Elements of Safety Program, Effective Realization, Economic and Social Benefits from Safety Program, Effective Communication Training at various levels of Production and Operation, Accidents identification and prevention. | 05 | 15 |
| 3. | **Potential Hazards in Chemical Process Industries**<br>Chemical and Physical job Safety Analysis, High pressure and Temperature Operation, Dangerous and Toxic Chemicals, Routes of entry, Effects of toxicants and its elimination, Toxic release and dispersion models, Radio Active materials, Safe Handling and Operation of materials and Machinery, Periodic inspection and replacement. | 05 | 20 |

| Section II | | | |
|---|---|---|---|
| **Module** | **Content** | **Hours** | **Weightage in %** |
| 4. | **Risk Assessment**<br>Quantitative risk assessment, Rapid and comprehensive risk analysis, Risk due to Radiation, Explosion due to over pressure, Plant layout Personnel Safety and Protective Equipment, Occupational health and safety. | 04 | 10 |
| 5. | **Hazard Identification**<br>Introduction to Hazard identification - Overall risk and hazard analysis, Emergency planning - On site & off site emergency planning, Risk management, ISO 14000, Safety audits, Checklist, What if analysis – Vulnerability models - Event tree analysis - Fault tree analysis. | 04 | 15 |
| 6. | **HAZOP**<br>HAZOP study - case studies, Pumping system, Reactor- mass transfer system, Hazard Identification and Assessment, Involvement of Human factors and Errors- Hazard Quantifications, Disaster management, Occupational and Industrial Health Hazards, Safety Systems. | 04 | 15 |
| 7. | **Case studies**<br>Dominos effect, Worst case scenario, Fire, Accidents, Chemical release, Explosion, Petroleum, Commercial, Natural disasters, EMS models case studies. | 03 | 10 |
| | **TOTAL** | **30** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Hazard Analysis Techniques for System Safety | Ericson C.A | 2nd edition. Wiley, USA, 2015. |
| Industrial Safety and Environment | Gupta A. | 2nd edition. Laxmi Publications, India, 2015 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Guidelines for process hazards analysis, hazards identification & risk analysis | Hyatt, N. | 1st edition. CRC Press, USA, 2003. |

**Web Material Links:**

https://nptel.ac.in/courses/110/105/110105094/ (Lecture Series by Prof. JhareswarMaiti, Department of Mechanical Engineering, IIT Kharagpur)

**Course Evaluation:**

**Theory:**

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration.

- Submission of Power point presentation which is to be presented by the students in a group of 3 students and it carried 10 marks of evaluation.
- End semester examination will consist of 60 marks.

**Course Outcome(s):**

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

| **SECH3290** | **Process Plant Safety Health and Hygiene** |
|---|---|
| CO 1 | Identify and analyse various types of hazards present in the chemicals processing and testing methodology followed by monitoring and controlling them. |
| CO 2 | Identify the methods of hazard identification and preventive measures. |
| CO 3 | Evaluate the safety performance of an organization from accident records. |
| CO 4 | Identify onsite and offsite emergency plans. |

**Mapping of CO with PO**

| **SECH3290** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | | 1 | | | | | | | | |
| CO 2 | 1 | 1 | 1 | | | 2 | | | | | | |
| CO 3 | | 1 | 1 | | 1 | 3 | 2 | 1 | | 2 | | 2 |
| CO 4 | | 1 | 1 | | | | | 3 | 2 | 2 | | |

**Mapping of CO with PSO**

| **SECH3290** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | | |
| CO 2 | | | 2 |
| CO 3 | 1 | | 3 |
| CO 4 | 1 | | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Introduction to Safety in Chemical process Industries | 1,4 |
| 2 | Safety Programs in Industries | 2,5 |
| 3 | Potential Hazards in Chemical Process Industries | 2,4 |
| 4 | Risk Assessment | 2,4,5,6 |
| 5 | Hazard Identification | 2,4,5,6 |
| 6 | HAZOP | 2,4,5 |
| 7 | Case studies | 6 |

**P P Savani University**
**School of Engineering**
**Department of Chemical Engineering**

Course Code: SECH3650
Course Name: Design of Experiments
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | -- | 03 | 40 | 60 | | | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- perform an error analysis for various numerical methods.
- derive appropriate numerical methods to solve non-linear algebraic and transcendental equations and linear system of equations.
- develop appropriate numerical methods to approximate a function.
- provide appropriate numerical methods to calculate a definite integral and to evaluate a derivative at a value.
- develop appropriate numerical methods to solve an ordinary differential equation.
- understand the various techniques to solve Partial differential equations.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Introduction to MATLAB Programming**<br>Basics of MATLAB programming, Array operations in MATLAB, Array operations in MATLAB, working with files: Scripts and Functions, Plotting and program output | 05 | 12 |
| 2. | **Approximations and Errors**<br>Defining errors and precision in numerical methods, Truncation and round-off errors, Error propagation, Global and local truncation errors | 04 | 18 |
| 3. | **Numerical Differentiation and Integration**<br>Numerical Differentiation in single variable, Numerical differentiation: Higher derivatives, Differentiation in multiple variables, Newton-Cotes integration formulae, Multi-step application of Trapezoidal rule, MATLAB functions for integration | 06 | 20 |
| **Section II** | | | |
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 4. | **Linear Equations**<br>Linear algebra in MATLAB, Gauss Elimination, LU decomposition and partial pivoting, Iterative methods: Gauss Siedel, Special Matrices: Tri-diagonal matrix algorithm | 08 | 25 |

| | | | |
|---|---|---|---|
| 5. | **Nonlinear Equations**<br>Nonlinear equations in single variable, MATLAB function fzero in single variable, Fixed-point iteration in single variable, Newton-Raphson in single variable, MATLAB function fsolve in single and multiple variables, Newton-Raphson in multiple variables | 07 | 25 |
| | **TOTAL** | **30** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Applied Numerical Analysis using MATLAB | L. V. Fausett | Pearson Education |
| Numerical Methods for Engineers - 5th Edition | S. C. Chapra& R. P. Kanale | McGraw-Hill |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Textbook on Computational Methods | B. R. GT Kochav | NiraliPrakashan |
| Numerical Methods for Scientific & Engineering Computation | M. K Jain, S. R. K. Lyenger | Wiley Eastern Ltd. |

**Web Material Link(s):**

- https://nptel.ac.in/syllabus/103106118/

**Course Evaluation:**

- Continuous Evaluation consists of Performance of Practical to be evaluated out of 10 marks for each practical and average of the same will be converted to 30 marks.
- Internal Viva consists of 20 marks.
- Practical performance/quiz/drawing/test/submission of 30 marks during End Semester Exam.
- Viva/Oral performance of 20 marks during End Semester Exam.

**Course Outcome(s):**

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

| SECH3650 | DESIGN OF EXPERIMENTS |
|---|---|
| CO 1 | Perform an error analysis for a given numerical method. |
| CO 2 | Solve a linear system of equations and non linear algebraic or transcendental equation using an appropriate numerical method. |
| CO 3 | Calculate a function using an appropriate numerical method. |
| CO 4 | Predict the basics of matlab and implement it in solving complex chemical engineering problems. |

**Mapping of CO with PO**

| SECH3650 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | | | | 2 | 1 | | | 1 | | 1 |
| CO 2 | | 1 | | | | | | | | | | |
| CO 3 | 1 | | | | | | | | | | | |
| CO 4 | | | | | | 2 | | | | 2 | | 1 |

**Mapping of CO with PSO**

| SECH3650 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | |
| CO 2 | | | 1 |
| CO 3 | | 1 | |
| CO 4 | | | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Introduction to MATLAB Programming | 1,2,3, |
| 2 | Approximations and Errors | 2,3,4,5, |
| 3 | Numerical Differentiation and Integration | 3,4,5 |
| 4 | Linear Equations | 1,2,3,4,5,6 |
| 5 | Nonlinear Equations | 1,2,3,4,5,6 |

**P P Savani University**
**School of Engineering**
**Department of Chemical Engineering**

Course Code: SECH3620
Course Name: Sustainability, Green Chemistry and Engineering
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | -- | -- | 03 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand the fundamentals of EM and ecosystem.
- understand various Environmental policies, legislations and international treaties.
- know concept of environmental impact assessment (EIA) and the preparation of EIA report.
- learn methodology and Processes of environmental auditing.
- understand life cycle assessment (LCA) and various EM system standards.
- decide environmental design and economics.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 1. | **Environmental Management** Principles of Environmental Management, Ecosystem concept, Environmental concerns in India, Policy and Legal Aspects of EM. | 05 | 10 |
| 2. | **Environmental Policies** Introduction to Environmental policies**,** Environmental Laws and Legislations, Environmental Legislation in India. | 06 | 10 |
| 3. | **Environmental Impact Assessment (EIA)** Introduction, Impact Prediction, Evaluation and Mitigation, Forecasting Environmental Changes, Strategic Environmental Assessment (SEA), Environmental Clearance Procedure in India. | 06 | 15 |
| 4. | **EIA Documentation and Processes** EIA Monitoring and Auditing, Environmental Auditing, Elements of Audit Process, Waste Audit and Pollution Prevention Assessments. | 05 | 15 |
| **Section II** | | | |
| **Module No.** | **Content** | **Hours** | **Weightage in %** |
| 5. | **EA in Industrial Projects** Liability Audits and Site Assessment, Auditing of EM, Life Cycle Assessment (LCA), Stages in LCA of a Product, Procedures for LCA, Different Applications of LCA. | 07 | 20 |
| 6. | **Environmental Management System (EMS)** Environmental Management System Standards, EMS Standards: ISO | 05 | 10 |

| | | | |
|---|---|---|---|
| | 14000, Implementation of EMS Conforming to ISO 14001, Environmental management techniques, Application of Remote Sensing and GIS in EM. | | |
| 7. | **Ecosystem and Environmental Design**<br>Ecosystem approach to risk assessment, Environmental Design, ED for Manufactured Products, ED for Buildings, ED for Developmental Planning. | 04 | 10 |
| 8. | **Environmental Economics**<br>Environmental Economics, Economics and the Environment, Environmental Valuation, Economics of Natural Resource, Environmental and Regional Economics, Ecological Economics. | 07 | 10 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Authors | Publication |
|---|---|---|
| Environmental Management | Vijay Kulkarni and Ramachandra T.V. | Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Management of Municipal Solid Waste | Ramachandra T.V. | Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore |
| Soil and Groundwater Pollution from Agricultural Activities | Ramachandra T.V. | Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore |

**Web Material Link(s):**

- www.ces.iisc.ernet.in/energy
- www.wgbis.ces.iisc.ernet.in
- www.ces.iisc.ernet.in/biodiversity
- www.astra.iisc.ernet.in

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

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

| SECH3620 | SUSTAINABILITY, GREEN CHEMISTRY AND ENGINEERING |
|---|---|
| CO 1 | Identify the objectives, scope and concept of ems in process industries. |
| CO 2 | Summarize the importance of environmental attributes. |
| CO 3 | Illustrate the necessity of public participation in eia studies. |
| CO 4 | Identify impacts for various developmental projects. |

**Mapping of CO with PO**

| SECH3620 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | | | | 2 | 2 | | 3 | | | |
| CO 2 | | | | | | | 1 | | 2 | | 2 | |
| CO 3 | | | | | | | | | 2 | | 1 | |
| CO 4 | 1 | | | | | | | | 1 | | 2 | |

**Mapping of CO with PSO**

| SECH3620 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | 2 |
| CO 2 | 3 | | 3 |
| CO 3 | 1 | | 1 |
| CO 4 | 2 | | 2 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Environmental Management | 1,2 |
| 2 | Environmental Policies | 1,2 |
| 3 | Environmental Impact Assessment (EIA) | 1,2 |
| 4 | EIA Documentation and Processes | 1,2 |
| 5 | EA in Industrial Projects | 1,2 |
| 6 | Environmental Management System (EMS) | 1,2 |
| 7 | Ecosystem and Environmental Design | 1,2 |
| 8 | Environmental Economics | 1,2 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3660
Course Name: Chemical Engineering Plant Design and Economics
industries Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 00 | 00 | 03 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand the designing the process plants or creating design layouts of plant.
- understand fundamentals of chemical engineering viz. development of flow diagrams, importance of various design consideration during the development and design of any process.
- rapidly increase advancement of knowledge and relevant importance and application of various process auxiliaries and utilities used in industries.
- deals with the basics as well as advanced understanding of various process auxiliaries and utilities used in chemical plant.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Process Auxiliaries**<br>Basic Considerations and Flow Diagrams in Chemical Engineering Plant Design. | 03 | 05 |
| 2. | **Piping Design**<br>Selection of Material, Pipe Sizes, Working Pressure, Basic Principles of Piping Design, Piping Drawings, Pipe Installations, Overhead Installations, Process Steam Piping, Selection and Determination of Steam – Pipe Size, Piping Insulation, Application of Piping Insulation, Weather Proof and Fire Resisting Pipe Insulation Jackets, Piping Fittings, Pipe Joints. | 10 | 20 |
| 3. | **Valves**<br>Types of Valves, Selection Criteria of Valves for various systems. | 05 | 10 |
| 4. | **Pumps**<br>Types of Pumps, NPSH Requirement, Pump Location, Pump Piping, Pump Piping Support, Process Control and Instrumentation Diagram, Control System Design for Process Auxiliaries. | 05 | 15 |
| **Section II** | | | |

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 5. | **Process Utilities**<br>Process Water: Sources of Water, Hard and Soft water, Requisites of Industrial Water and its Uses, Methods of Water Treatment, Chemical Softening, Demineralization, Resins Used for Water Softening, Water for Boiler, Cooling Purposes, cooling towers, Drinking and Process Water Treatment. | 08 | 15 |
| 6. | **Steam**<br>Steam Generation and its Application in Chemical Process Plants, Distribution and Utilization, Steam Economy, Condensate Utilization, Steam Traps and their Characteristics, Selection and Application, Waste Heat Utilization. | 08 | 15 |
| 7. | **Compressors and Vacuum Pumps**<br>Types of Compressors and Vacuum Pumps and their Performance Characteristics, Methods of Vacuum Development and their Limitations, Materials Handling Under Vacuum, Lubrication and Oil Removal in Compressors and Pumps, Instrument Air. | 04 | 15 |
| 8. | **Refrigeration System**<br>Refrigeration and Chilling Systems, Oil Heating Systems, Nitrogen Systems. | 02 | 5 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Process Plant layout and Piping Design | Roger Hunt and Ed Bausbacher | PTR Prentice-Hall Inc |
| Process utility systems | Jack Broughton | Institution of Chem. Engineers, U.K. |

**Reference Book(s):**

| | | |
|---|---|---|
| Chemical Engineering Plant Design | F.C. Vibrandt and C.E. Dryden | McGraw Hill, Fifth Edition |
| Plant design and Economics for Chemical Engineers | M.S. Peters and Timmerhaus | Mc Graw Hill 3rd Edition |

**Web Material Link(s):**

- https://nptel.ac.in/syllabus/105102089/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

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

| SECH3660 | CHEMICAL ENGINEERING PLANT DESIGN AND ECONOMICS |
|---|---|
| CO 1 | Describe overall knowledge about the process plant. |

| | |
|---|---|
| CO 2 | Anlayze the importance of process auxiliaries and utilities in process industries. |
| CO 3 | Apply the conceptual design of chemical process plant. |
| CO 4 | Build a bridge between theoretical and practical concepts used for process auxiliaries and utilities in any process industry. |

**Mapping of CO with PO**

| **SECH3660** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | | | | 2 | 1 | | | 1 | | 1 |
| CO 2 | | 1 | | | | | | | | | | |
| CO 3 | 1 | | | | | | | | | | | |
| CO 4 | | | | | | 2 | | | | 2 | | 1 |

**Mapping of CO with PSO**

| **SECH3660** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | |
| CO 2 | | | 1 |
| CO 3 | | 1 | |
| CO 4 | | | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Process Auxiliaries | 1,2,3,4 |
| 2 | Piping Design | 1,2,3,4,5,6 |
| 3 | Valves | 1,2,3,4 |
| 4 | Pumps | 1,2,3,4 |
| 5 | Process Utilities | 1,2,3,4 |
| 6 | Steam | 1,3,4,5 |
| 7 | Compressors and Vacuum Pumps | 1,2,3,4,5 |
| 8 | Refrigeration System | 1,2,4 |

**P P Savani University**
**School of Engineering**

## Department of Chemical Engineering

Course Code: SECH3680
Course Name: Chemical Process Development and Design
Prerequisite Course(s): SECH3062 - Process Equipment & Design-I

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 00 | 00 | 03 | 40 | 60 | | 0 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand modifications and additions to existing plants or creating design layouts of plant / Equipment.
- rapidly increase rate in the advancement of knowledge and relevant application for equipment design.
- observe conclusively the practices in using the reference literature and software.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Chemical Engineering Design** Process Design, Mechanical aspects of process equipment design, General design procedure, Equipment classifications, Design codes and standards (IS, ASTM and BS). | 02 | 05 |
| 2. | **Process Design of Piping, Fluid Moving Devices and Flow meters** Introduction, Process Design of Piping, Npsha & Npshr, Power Required by Pump, Evaluation of Centrifugal Pump Performance When Handling Viscous Liquids, Power Required in Fan, Blower and Adiabatic Compressor, Flow Meters, Process Design of Orifice Meter, Rotameter Etc. | 10 | 20 |
| 3. | **Process Design of Extractor** Industrial Applications of Liquid-Liquid Extraction, Choice of Solvent, Process Design of Counter Current Multistage Extractor, Selection Criteria among Different Types of Extractor, Process Design of Mixer-Settler Type Extractor & Packed Tower Type Extractor, Guidelines for the Design of Other Types of Extractors | 10 | 25 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 4. | **Mechanical design of Reaction Vessel** Mechanical Design of Shell, Head, Jacket, Coil, Agitator, Nozzle, Body Flange, Etc., Different Types of Agitators & their Selection Criteria, Different Types of Agitator Shaft Sealing System & their Selection Criteria, Different Types of Power Transmission System, | 10 | 20 |

| | | | |
|---|---|---|---|
| | Determination of Power Required for Agitation, Shaft Diameter, Blade Thickness, Etc. | | |
| 5. | **Mechanical design of Storage Tan**<br>Classification of Storage Tank as Per Is-803, Capacity of Storage Tank, Its Diameter & Height, Design of Shell and Bottom Plate for Storage Tank, Design of Self Supported Conical Roof, Design of Structured Supported Conical Roof as Per Api 620, Selection of Column, Girders and Rafters, Roof Curb Angel, Floating Roof | 08 | 18 |
| 6. | **Supports**<br>Different Types of Supports, Mechanical Design of Bracket Support, Skirt, Support & Saddle Support, Numerical | 05 | 12 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering - Volume 6 (3rd Edition) | Sinnott. R.K, Coulson & Richardson's | Butterworth Heinemann, New Delhi, 1999 |
| Chemical Engineers Handbook - Perry's (7th Edition) | Perry. R.H., et al. | McGraw Hill, NewYork, 1997 |
| Process Equipment Design | Bownell, L.E., and Young, E.M | Wiley Eastern, 1968 |
| Introduction to Process Engineering and Design (1st Edition) | S B Thakore and B I Bhatt | Tata McGraw Hill, 2007 |
| Process Equipment Design | Joshi. M.V. and Mahajani. V.V | Macmillan India Limited, New Delhi, 1996 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Process Equipment: Design and Drawing | Maidargi, Suresh C. | Maidargi, Suresh C. |
| Introduction to Chemical Equipment Design: Mechanical Aspects | Bhattacharyy, B C. | CBS Publisher, 2012 |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103103027/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/drawing/test consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

After the completion of the course, the following course outcomes will be able to

| SECH3680 | CHEMICAL PROCESS DEVELOPMENT AND DESIGN |
|---|---|
| CO 1 | Anlayze the pumping power required in different pipe fittings and flow meters. |
| CO 2 | Design of column/support, etc for extractor. |
| CO 3 | Estimate reactor and storage sizings used for industrial applications. |
| CO 4 | Classify different supports used in process industry. |

**Mapping of CO with PO**

| SECH3680 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | | | | 2 | 1 | | | 1 | | 1 |
| CO 2 | | 1 | | | | | | | | | | |
| CO 3 | 1 | | | | | | | | | | | |
| CO 4 | | | | | | 2 | | | | 2 | | 1 |

**Mapping of CO with PSO**

| SECH3680 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | |
| CO 2 | | | 1 |
| CO 3 | | 1 | |
| CO 4 | | | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction to Chemical Engineering Design | 1,2 |
| 2 | Process Design of Piping, Fluid Moving Devices and Flow meters | 1,2,4,6 |
| 3 | Process Design of Extractor | 1,2,4,6 |
| 4 | Mechanical design of Reaction Vessel | 1,2,4,6 |
| 5 | Mechanical design of Storage Tan | 1,2,4,6 |
| 6 | Supports | 1,2,4,6 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH3670
Course Name: New Separation
Techniques Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 00 | 00 | 03 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- enable to understand membrane-based separation problems by acquiring in-depth knowledge in the area of membrane separation mechanisms, transport models, membrane materials and modules.
- focus particularly on various applications of membrane science and technology.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Rate Governed and Equilibrium Membrane Separation Processes** Fundamentals, Types of Membranes, Modules, Flow Patterns, Preparation and Characterization of Membranes, Melt Pressing, Film Stretching, Sol-gel Peptization, Interfacial Polymerization etc. Measurement of Pore Size and Solute Rejection Properties. | 06 | 15 |
| 2. | **Reverse Osmosis** Design and Operating Parameters, Various Transport Models, Kedem-katchalsky Model, Spiegler-kedem Model, Solution-diffusion Model, Concentration Polarization and Flux Decline, Design of an RO module, Forward Osmosis | 06 | 15 |
| 3. | **Nanofiltration** Transport Mechanism in NF Membranes, Parameters affecting the Performance of NF Membranes, Fouling Model, Determination of Various Resistances | 06 | 10 |
| 4. | **Ultrafiltration** Factors Affecting Performance of Ultrafiltration, Resistance Model, Gel Polarization Model, Fouling and Flux Decline, Micellar-Enhanced Ultrafiltration, Affinity Ultrafiltration, Microfiltration Advances. | 05 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 5. | **Membrane Gas Separation** | 07 | 20 |

| | | | |
|---|---|---|---|
| | Membranes for Gas Separation, Fundamental Mechanism of Gas Transport, Knudsen Diffusion, Molecular Sieving, Solution Diffusion, Dual Sorption Model, Factors Affecting Gas Permeation, Complete Mixing Model, Solution of Equations, Equations for Multicomponent Mixtures, Cross - Flow Model, Countercurrent Model, Applications | | |
| 6. | **Pervaporation**<br>Mass Transfer and Thermodynamics Aspects of Pervaporation, Temperature Drop at Membrane Interface | 05 | 10 |
| 7. | **Dialysis**<br>Principle of Dialysis, Dialysis Systems, Mass Transfer in Dialysis, Modeling of Solute Transport in Hemodialyzer, Advantages of Diffusion Dialysis, Application of Diffusion Dialysis, Electrodialysis | 06 | 10 |
| 8. | **Membrane Reactor**<br>Membrane Bioreactor, Membrane Distillation | 04 | 10 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Membrane technology and applications | Baker, R.W. | 2nd ed., John Wiley 2004 |
| Membrane separation Processes | K Nath | Prentice Hall of India, New Delhi |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Basic Principles of Membrane Separation | Mudler J | (2nd Edition), Springer |

**Web Material Link(s):**
https://nptel.ac.in/courses/103105121/

**Course Evaluation:**
**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Submission of power point presentation which is to be presented by the students in a group of 3 which carries 10 marks of evaluation.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**
After the completion of the course, the students will be able to

| SECH3670 | NEW SEPARATION TECHNIQUES |
|---|---|
| CO 1 | Identify and describe the main unit operations associated with membrane technology. |
| CO 2 | Describe the main industrial applications of membrane technology. |
| CO 3 | Calculate mean flux, selectivity and membrane area for the different membrane processes. |
| CO 4 | Employ membrane technology knowledge to discuss recent journal articles in the membrane field and compare the with similar separation processes. |

**Mapping of CO with PO**

| SECH3670 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | | | | 2 | 1 | | | 1 | | 1 |
| CO 2 | | 1 | | | | | | | | | | |
| CO 3 | 1 | | | | | | | | | | | |
| CO 4 | | | | | | 2 | | | | 2 | | 1 |

**Mapping of CO with PSO**

| SECH3670 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | |
| CO 2 | | | 1 |
| CO 3 | | 1 | |
| CO 4 | | | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Rate Governed and Equilibrium Membrane Separation Processes | 1,2,4 |
| 2 | Reverse Osmosis | 1,2 |
| 3 | Nanofiltration | 1,2 |
| 4 | Ultrafiltration | 1,2 |
| 5 | Membrane Gas Separation | 1,2 |
| 6 | Pervaporation | 1,2 |
| 7 | Dialysis | 1,2 |
| 8 | Membrane Reactor | 1,2 |

**P P Savani University**
**School of Engineering**

## Department of Chemical Engineering

Course Code: SECH3640

Course Name: Polymer Engineering

Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 3 | 0 | 0 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help learners to

- have basic knowledge of the design and operation of pharmaceutical units and of the steps of development of dosage forms through to the final product and submission to the Health authorities for Production license and marketing.
- clear the concept and the importance of particle size and particle shape in drug formulation.
- understand of the mechanism of basic pharmaceutical operations including size reduction, mixing, separation processes, filtration, drying and freeze-drying, its importance in drug formulation and practical application on a laboratory scale.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Basic Pharmaceutical and Fine Chemical Industry**<br>Definitions of Basic Pharmaceuticals, Intermediates, Fine Chemicals, Heavy Chemicals, Technology involved in Manufacturing of Pharmaceuticals, Unit Processes in Synthesis,<br>Biochemical Processes in Synthesis. | 06 | 15 |
| 2. | **Unit Processes involved in Pharma Industry**<br>Study of the Following Chemical Processes (With References to Reagents, Mechanisms, Equipment and Manufacture of Drugs given below): Acylation, Esterification, Alkylation, Amination, Halogenation, Hydrolysis, Nitration, Oxidation and Reduction. | 06 | 10 |
| 3. | **Unit Operations involved in Pharma Industry**<br>Operation of Reactor, Centrifuge, Dryer, Cooling Tower, Heat Exchanger – Design, Working Principle, Validation and Cleaning. | 10 | 25 |
| **Section II** | | | |
| Module No.. | Content | Hours | Weightage in % |

| | | | |
|---|---|---|---|
| 4. | **Solid Formulation**<br>Basics of Process Automation of Solid Dosage Form Production, Study of Newer Excipients used in Gastro Retentive, Mucoadhesive Systems and Colon Specific and Sustained Release, Pulsatile Drug Delivery Systems, Formulation Development of Mouth Dissolving Tablets, Taste Masking Formulation, Sublingual and Buccal Formulations. | 07 | 15 |
| 5. | **Liquid Formulation**<br>Study of Advances in Liquid Formulation including Multiple Emulsion, Micro Emulsion including Self Emulsified Drug Delivery Systems and Self Micro Emulsified Drug Delivery Systems. | 05 | 10 |
| 6. | **Semisolids Formulation**<br>Semisolid Formulation with Special Reference to Penetration Enhancers, Emulgels, Semisolids based on Liposomes, Niosomes. | 04 | 10 |
| 7. | **Inhalation Aerosols**<br>Inhalation Products- Types and Clinical Role, Basic Components of Aerosol Formulations, Therapeutic Aerosols, Metered Dose Inhalers, Dry powder Inhalers, Detailed Discussion on Propellants, Package and Filling Technology, Quality Assurance of Components and Formulations | 07 | 15 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Modern Pharmaceutics - Fourth Edition | Gilbert and S. Banker and Christofer T. Rhodes | Marcel Decker Series |
| Advanced Pharmaceutics: Physicochemical principles | Cherng-Ju uim | CRC Press – 2004 |
| Unit Processes in Pharmacy | Ganderton David | Elsevier Ltd. |
| The Theory and Practice of Industrial Pharmacy | L. Lachman | CBS Publishers |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Physical characterization of Pharmaceutical Solids - Volume 70 | H. T. Brittain | Marcel-Decker Series |

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

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

| SECH3640 | POLYMER ENGINEERING |
|---|---|
| CO 1 | Identify basic unit processes and unit operations involved in pharma industry. |
| CO 2 | Relate the different equipment with usage and applications. |
| CO 3 | Differentiate api and formulation in the pharmaceutical industries |

| | |
|---|---|
| CO 4 | Apply knowledge of basic science in dosage and formulation to enhance the plant efficiency. |

**Mapping of CO with PO**

| SECH3640 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | | | | 2 | 1 | | | 1 | | 1 |
| CO 2 | | 1 | | | | | | | | | | |
| CO 3 | 1 | | | | | | | | | | | |
| CO 4 | | | | | | 2 | | | | 2 | | 1 |

**Mapping of CO with PSO**

| SECH3640 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | |
| CO 2 | | | 1 |
| CO 3 | | 1 | |
| CO 4 | | | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction to Basic Pharmaceutical and Fine Chemical Industry | 1,2 |
| 2 | Unit Processes involved in Pharma Industry | 1,2 |
| 3 | Unit Operations involved in Pharma Industry | 1,2 |
| 4 | Solid Formulation | 1,2 |
| 5 | Liquid Formulation | 1,2 |
| 6 | Semisolids Formulation | 1,2 |
| 7 | Inhalation Aerosols | 1,2 |

**P P Savani University**
**School of Engineering**
**Department of Chemical Engineering**

Course Code: SECH3630
Course Name: Waste to Energy Conversation
Prerequisite Course(s):

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 00 | 00 | 03 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand the fundamentals of EM and ecosystem.
- understand various Environmental policies, legislations and international treaties.
- know concept of environmental impact assessment (EIA) and the preparation of EIA report.
- learn methodology and Processes of environmental auditing.
- understand life cycle assessment (LCA) and various EM system standards.
- decide environmental design and economics.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Environmental Management** Principles of Environmental Management, Ecosystem concept, Environmental concerns in India, Policy and Legal Aspects of EM. | 05 | 10 |
| 2. | **Environmental Policies** Introduction to Environmental policies**,** Environmental Laws and Legislations, Environmental Legislation in India. | 06 | 10 |
| 3. | **Environmental Impact Assessment (EIA)** Introduction, Impact Prediction, Evaluation and Mitigation, Forecasting Environmental Changes ,Strategic Environmental Assessment (SEA), Environmental Clearance Procedure in India. | 06 | 15 |
| 4. | **EIA Documentation and Processes** EIA Monitoring and Auditing, Environmental Auditing, Elements of Audit Process, Waste Audit and Pollution Prevention Assessments. | 05 | 15 |

| **Section II** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |

| | | | |
|---|---|---|---|
| 5. | **EA in Industrial Projects**<br>Liability Audits and Site Assessment, Auditing of EM, Life Cycle Assessment (LCA), Stages in LCA of a Product, Procedures for LCA, Different Applications of LCA. | 07 | 20 |
| 6. | **Environmental Management System (EMS)**<br>Environmental Management System Standards, EMS Standards: ISO 14000, Implementation of EMS Conforming to ISO 14001, Environmental management techniques, Application of Remote Sensing and GIS in EM. | 05 | 10 |
| 7. | **Ecosystem and Environmental Design**<br>Ecosystem approach to risk assessment, Environmental Design, ED for Manufactured Products, ED for Buildings, ED for Developmental Planning. | 04 | 10 |
| 8. | **Environmental Economics**<br>Environmental Economics, Economics and the Environment, Environmental Valuation, Economics of Natural Resource, Environmental and Regional Economics, Ecological Economics. | 07 | 10 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Authors | Publication |
|---|---|---|
| Environmental Management | Vijay Kulkarni and Ramachandra T.V. | Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Management of Municipal Solid Waste | Ramachandra T.V. | Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore |
| Soil and Groundwater Pollution from Agricultural Activities | Ramachandra T.V. | Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore |

**Web Material Link(s):**

- www.ces.iisc.ernet.in/energy
- www.wgbis.ces.iisc.ernet.in
- www.ces.iisc.ernet.in/biodiversity
- www.astra.iisc.ernet.in

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

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

| SECH3630 | WASTE TO ENERGY CONVERSATION |
|---|---|
| CO 1 | Identify the objectives, scope and concept of ems in process industries. |
| CO 2 | Summarize the importance of environmental attributes. |
| CO 3 | Illustrate the necessity of public participation in eia studies. |
| CO 4 | Identify impacts for various developmental projects. |

**Mapping of CO with PO**

| SECH3630 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | | | | 2 | 1 | | | 1 | | 1 |
| CO 2 | | 1 | | | | | | | | | | |
| CO 3 | 1 | | | | | | | | | | | |
| CO 4 | | | | | | 2 | | | | 2 | | 1 |

**Mapping of CO with PSO**

| SECH3630 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | |
| CO 2 | | | 1 |
| CO 3 | | 1 | |
| CO 4 | | | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Environmental Management | 1,2 |
| 2 | Environmental Policies | 1,2 |
| 3 | Environmental Impact Assessment (EIA) | 1,2 |
| 4 | EIA Documentation and Processes | 1,2 |
| 5 | EA in Industrial Projects | 1,2 |
| 6 | Environmental Management System (EMS) | 1,2 |
| 7 | Ecosystem and Environmental Design | 1,2 |
| 8 | Environmental Economics | 1,2 |

**P P Savani University**
**School of Engineering**

## Department of Chemical Engineering

Course Code: SECH3610
Course Name: Corrosion and Electrochemical Engineering
Prerequisite Course(s):

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 00 | 00 | 03 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand the fundamentals of EM and ecosystem.
- understand various Environmental policies, legislations and international treaties.
- know concept of environmental impact assessment (EIA) and the preparation of EIA report.
- learn methodology and Processes of environmental auditing.
- understand life cycle assessment (LCA) and various EM system standards.
- decide environmental design and economics.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Corrosion**<br>Definition and significance of corrosion, Types and forms of corrosion: dry and wet corrosion, atmospheric, galvanic, pitting, crevice, intergranular, stress corrosion cracking. Thermodynamics and kinetics of corrosion reactions. Electrochemical cells, EMF series, and Pourbaix diagrams. | 05 | 10 |
| 2. | **Electrochemical Fundamentals**<br>Faraday's laws of electrolysis, Electrode potential, Nernst equation, Electrochemical cells, Polarization – types and effects, Butler-Volmer equation, Tafel plots, corrosion current, mixed potential theory, Electrochemical measurement techniques. | 06 | 10 |
| 3. | **Corrosion Control Methods – I**<br>Cathodic and anodic protection: principles, design and applications. Use of sacrificial anodes, impressed current systems, coatings – organic and inorganic. Corrosion inhibitors: types, selection and applications. | 06 | 15 |
| 4. | **Corrosion Testing and Monitoring**<br>Laboratory and field testing techniques – weight loss, potentiostatic and galvanostatic techniques, electrochemical impedance spectroscopy (EIS), corrosion probes, real-time monitoring, evaluation of corrosion rate. | 05 | 15 |
| **Section II** | | | |

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 5. | **High-Temperature and Microbiological Corrosion**<br>Oxidation, carburization, sulfidation, hot corrosion mechanisms. Microbial-induced corrosion (MIC), sulfate-reducing bacteria, detection and control methods. | 07 | 20 |
| 6. | **Corrosion in Specific Environments**<br>Corrosion in soil, marine, high-temperature, and chemical plant environments. Corrosion in reinforced concrete and underground pipelines. Case studies from oil & gas, power plants, and chemical industries. | 05 | 10 |
| 7. | **Electrochemical Engineering Applications**<br>Principles and applications of electrochemical cells in industrial processes – electroplating, electrowinning, electrorefining, electroforming, batteries and fuel cells. Cell design, current distribution, and scale-up. | 04 | 10 |
| 8. | **Corrosion in Material Selection and Design**<br>Material selection criteria, corrosion-resistant materials: stainless steels, alloys, ceramics, composites. Designing for corrosion prevention. Economic impact and life cycle cost analysis. | 07 | 10 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Authors | Publication |
|---|---|---|
| Environmental Management | Vijay Kulkarni and Ramachandra T.V. | Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Management of Municipal Solid Waste | Ramachandra T.V. | Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore |
| Soil and Groundwater Pollution from Agricultural Activities | Ramachandra T.V. | Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore |

**Web Material Link(s):**

- www.ces.iisc.ernet.in/energy
- www.wgbis.ces.iisc.ernet.in
- www.ces.iisc.ernet.in/biodiversity
- www.astra.iisc.ernet.in

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

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

| SECH3610 | CORROSION AND ELECTROCHEMICAL ENGINEERING |
|---|---|
| CO 1 | Identify the objectives, scope and concept of ems in process industries. |
| CO 2 | Summarize the importance of environmental attributes. |
| CO 3 | Illustrate the necessity of public participation in eia studies. |
| CO 4 | Identify impacts for various developmental projects. |

**Mapping of CO with PO**

| SECH3610 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | | | | | 2 | 1 | | | 1 | | 1 |
| CO 2 | | 1 | | | | | | | | | | |
| CO 3 | 1 | | | | | | | | | | | |
| CO 4 | | | | | | 2 | | | | 2 | | 1 |

**Mapping of CO with PSO**

| SECH3610 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | | |
| CO 2 | | | 1 |
| CO 3 | | 1 | |
| CO 4 | | | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Environmental Management | 1,2 |
| 2 | Environmental Policies | 1,2 |
| 3 | Environmental Impact Assessment (EIA) | 1,2 |
| 4 | EIA Documentation and Processes | 1,2 |
| 5 | EA in Industrial Projects | 1,2 |
| 6 | Environmental Management System (EMS) | 1,2 |
| 7 | Ecosystem and Environmental Design | 1,2 |
| 8 | Environmental Economics | 1,2 |

# FOURTH YEAR B. TECH.

| P P SAVANI UNIVERSITY | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCHOOL OF ENGINEERING | | | | | | | | | | | | | | | |
| TEACHING & EXAMINATION SCHEME FOR FOURTH YEAR B.TECH. PROGRAMME AY: AY: 2023-24 | | | | | | | | | | | | | | | |
| **Sem** | **Course Code** | **Course Title** | **Offered By** | **Teaching Scheme** | | | | | **Examination Scheme** | | | | | | |
| | | | | **Contact Hours** | | | | **Credit** | **Theory** | | **Practical** | | **Tutorial** | | **Total** |
| | | | | **Theory** | **Practical** | **Tutorial** | **Total** | | **CE** | **ESE** | **CE** | **ESE** | **CE** | **ESE** | |
| 7 | SECH4940 | Project/Training | CH | 0 | 23 | 0 | 23 | 23 | 0 | 0 | 200 | 300 | 0 | 0 | **500** |
| | | | | | | | | | | | | | | | |
| 8 | SECH4311 | Process Equipment & Design-II | CH | 2 | 0 | 2 | 4 | 4 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH4321 | Chemical Reaction Kinetics-II | CH | 2 | 2 | 0 | 4 | 3 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH4330 | Process Modeling and Simulation | CH | 2 | 2 | 0 | 4 | 3 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECH4340 | Transport Phenomena | CH | 2 | 0 | 2 | 4 | 4 | 40 | 60 | 0 | 0 | 40 | 60 | 200 |
| | | **Elective-II** | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | TNPC3020 | Creativity, Problem Solving & Innovation | TNPC | 0 | 2 | 0 | 0 | 0 | 2 | 2 | 100 | 0 | 0 | 0 | 100 |
| | SECH4500 | MOOC Course-II | CH | 3 | 0 | 0 | 0 | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | | | | | **Total** | **20** | **23** | | | | | | | **1100** |

| ELECTIVE-II COURSES | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sem** | **Course Code** | **Course Title** | **OfferedBy** | **Teaching Scheme** | | | | | **Examination Scheme** | | | | | | | |
| | | | | **Contact Hours** | | | | **Credit** | **Theory** | | **Practical** | | **Tutorial** | | **Total** |
| | | | | **Theory** | **Practical** | **Tutorial** | **Total** | | **CE** | **ESE** | **CE** | **ESE** | **CE** | **ESE** | |
| 8 | SECH4550 | Chemical System Modelling | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH4560 | Quality Control & Quality Assurance – Instrumentation & Validation Process | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH4570 | Membrane Technology | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH4580 | Industrial Health & Safety Engineering | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4960
Course Name: Project/Training
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| -- | 23 | -- | 23 | -- | -- | 200 | 300 | -- | -- | 500 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Outline of the Course:**

**Project**

- The project will be aligned with the aims of the engineering programme and its areas of specialization and shall be based on the recent trends in technology.
- The student shall carry out a comprehensive project at relevant academic / R&D / industrial organization.
- The student is required to submit a project report based on the work carried out.

**Training**

- The aim of this course is to use the internship experience to enable students to develop their engineering skills and practices.
- The student will be placed in industry/organization for 12 to 18 weeks and assessed for academic credit.
- The students may select industry on their own or one which is offered by institute.
- Students are expected to experience a real-life engineering workplace and understand how their engineering and professional skills can be utilized in industry.
- The student is required to submit a project report based on the work carried out.

**Course Outcome(s):**

After the completion of the course, the students will able to:

| **SECH4960** | **PROJECT / SUMMER INTERNSHIP** |
|---|---|
| CO 1 | Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study. |
| CO 2 | Determine the challenges and future potential for his/her internship organization in particular and the sector in general. |
| CO 3 | Test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period. |
| CO 4 | Apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship organization. |
| CO 5 | Analyze the functioning of internship organization and recommend changes for improvement in processes. |

**Mapping of CO with PO**

| SECH4960 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 |
| CO 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 |
| CO 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 |
| CO 4 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 |
| CO 5 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 |

**Mapping of CO with PSO**

| SECH4960 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 3 | 3 | 3 |
| CO 2 | 3 | 3 | 3 |
| CO 3 | 3 | 3 | 3 |
| CO 4 | 3 | 3 | 3 |
| CO 5 | 3 | 3 | 3 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Content | RBT Level |
|---|---|
| Project/Summer Internship | 1,2,3,4,5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4311
Course Name: Process Equipment & Design-II
Prerequisite Course(s): SECH3360 - Process Equipment Design and Drawing

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | 02 | 04 | 40 | 60 | -- | -- | 40 | 60 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand modifications and additions to existing plants or creating design layouts of plant / Equipment.
- rapidly increase rate in the advancement of knowledge and relevant application for equipment design.
- observe conclusively the practices in using the reference literature and software.

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | **Introduction to Chemical Engineering Design**<br>Process Design, Mechanical aspects of process equipment design, General design procedure, Equipment classifications, Design codes and standards. | 05 | 20 |
| 2. | **Process Design of Piping, Fluid Moving Devices and Flow meters**<br>Introduction, Process Design of Piping, Npsha&Npshr, Power Required by Pump, Evaluation of Centrifugal Pump Performance, Power Required in Fan, Blower and Adiabatic Compressor. | 05 | 15 |
| 3. | **Process Design of Extractor**<br>Industrial Applications of Liquid-Liquid Extraction, Choice of Solvent, Selection Criteria among Different Types of Extractor, Process Design of Mixer-Settler Type Extractor & Packed Tower Type Extractor. | 05 | 15 |
| 4. | **Mechanical design of Reaction Vessel**<br>Design of Shell, Jacket, Coil, Agitator, Nozzle, Body Flange, Etc., Different Types of Agitators &their Selection Criteria, Different Types of Agitator Shaft Sealing System &their Selection Criteria. | 05 | 10 |
| 5. | **Design of Pressure Vessels**<br>Design of pressure vessels under internal pressure, Construction features, Pressure vessel code, Design and construction features of thick-walled pressure vessels, Auxiliary process vessels.Design criteria for external design pressure, vessels operated under vacuum, Use of stiffeners, Design of covers, pipes and tubes. | 05 | 20 |
| 6. | **Mechanical design of Storage Tank and Supports** | 05 | 20 |

| | | | |
|---|---|---|---|
| | Capacity of Storage Tank, Its Diameter & Height, Design of Shell and Bottom Plate for Storage Tank, Design of Self Supported Conical Roof, Design of Structured Supported Conical Roof as Per Api 620, Selection of Column, Girders and Rafters, Roof Curb Angel, Floating Roof. Different Types of Supports, Mechanical Design of Bracket Support, Skirt, Support & Saddle Support, Numerical | | |
| | **TOTAL** | **30** | **100** |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Flow sheeting of piping | 02 |
| 2. | Flow sheeting of pumps | 02 |
| 3. | Flow sheeting of compressor | 02 |
| 4. | Flow sheeting of flow meters | 02 |
| 5. | Flow sheeting of extractor | 02 |
| 6. | Flow sheeting of agitated vessel | 04 |
| 7. | Flow sheeting of different types of agitator | 04 |
| 8. | Flow sheeting of different types of extractors | 04 |
| 9. | Flow sheeting of storage tank | 02 |
| 10. | Flow sheeting of bracket support | 02 |
| 11. | Flow sheeting of skirt support | 02 |
| 12. | Flow sheeting of saddle support | 02 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering - Volume 6 (3rd Edition) | Sinnott. R.K, Coulson & Richardson's | Butterworth Heinemann, New Delhi, 1999 |
| Chemical Engineers Handbook - Perry's(7thEdition) | Perry. R.H., et al. | McGraw Hill, NewYork, 1997 |
| Process Equipment Design | Bownell, L.E., and Young, E.M | Wiley Eastern, 1968 |
| Process Equipment Design | Joshi. M.V. and Mahajani. V.V | Macmillan India Limited, New Delhi, 1996 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Process Equipment: Design and Drawing | Maidargi, Suresh C. | Maidargi, Suresh C. |
| Introduction to Chemical Equipment Design: Mechanical Aspects | Bhattacharyy, B C. | CBS Publisher, 2012 |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103103027/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.

- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/drawing/test consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| **SECH4311** | **PROCESS EQUIPMENT & DESIGN-II** |
|---|---|
| CO 1 | Analyze the pumping power required in different pipe fittings and flow meters. |
| CO 2 | Design of column/support, etc for extractor. |
| CO 3 | Estimate reactor and storage sizingsused for industrial applications. |
| CO 4 | Classify different supports used in process industry. |
| CO 5 | Design process equipments subjected to internal pressure and external pressure. |

**Mapping of CO with PO**

| **SECH4311** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | | | | | | | | | | |
| CO 2 | 1 | 1 | | 1 | | | 1 | 1 | | | | |
| CO 3 | 2 | | 1 | 1 | | | | | | 1 | 1 | |
| CO 4 | 2 | 1 | 1 | | 1 | | | | | | | 1 |
| CO 5 | 2 | 1 | 1 | | 1 | | | | | | | 1 |

**Mapping of CO with PSO**

| **SECH4311** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | 1 | |
| CO 2 | 1 | | |
| CO 3 | 1 | | |
| CO 4 | | | 1 |
| CO 5 | 1 | 1 | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Introduction to Chemical Engineering Design | 1,2 |
| 2 | Process Design of Piping, Fluid Moving Devices and Flow meters | 1,2,4,6 |
| 3 | Process Design of Extractor | 1,2,4,6 |
| 4 | Mechanical design of Reaction Vessel | 1,2,4,6 |
| 5 | Design of Pressure Vessels | 1,2,4,6 |
| 6 | Mechanical design of Storage Tank and Supports | 1,2,4,6 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4211
Course Name: Chemical Reaction kinetics - II
Prerequisite Course(s): SECH3350 - Chemical Reaction Kinetics – I

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | 02 | -- | 04 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- comprehend residence time distributions, and how they can be used to characterize anddesign non-ideal reactors.
- understand the preparation of catalysis, solid-catalyzed reactions and heterogeneous reaction and its application in various chemical industries.
- kinetics and design of reactors for non-catalytic fluid-fluid and fluid-particle reactions.
- to know the basic operational principle of advance reactors and it's used in allied chemical industries.

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | **Non-Ideal Flow**<br>Basics of non-ideal flow, Residence time distribution, stimulus response techniques, The E, F and C Curves, their interrelationship, conversion in non-ideal flow reactors. | 06 | 15 |
| 2. | **Heterogeneous Reactions: Introduction**<br>Rate steps involved in heterogeneous systems, Overall rate expression for linear and non-linear process, contacting patterns for two-phase systems. | 06 | 15 |
| 3. | **Fluid-Fluid Systems**<br>The rate equation, Kinetic regimes for mass transfer and reaction, fast reaction, intermediate reaction, slow reaction, Slurry reaction kinetics, Application to design. | 08 | 20 |
| 4. | **Fluid-Particle Systems**<br>Fluid particles of single size, plug flow of solids, Mixture of particles of different and unchanging sizes, mixed flow of particles of a single unchanging size, Selection of a model, Determination of rate controlling step, Application to design, Application to fluidized bed. | 08 | 15 |
| 5. | **Catalysis**<br>Typical Catalysts used in chemical processes, Catalyst Characterizations, Catalyst Deactivation and Regeneration, Temperature Progression, Moving Bed Reactors, Metal recovery from the Spent Catalysts, Nano catalysis. | 08 | 20 |
| 6. | **Solid-Catalyzed Reactions: Kinetics and Catalytic Reactors** | 09 | 15 |

| | | | |
|---|---|---|---|
| | Configurations, Preparation, Hydrodynamics and Applications, Accelerated Deactivation of catalysts, Laboratory reactors, Oscillatory motion of reactants in catalyst pores, Microreactors. | | |
| | **TOTAL** | **45** | **100** |

**List of Practical**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | RTD study in Tubular reactor | 02 |
| 2. | RTD study in CSTR reactor | 04 |
| 3. | RTD study in Packed bed reactor | 04 |
| 4. | RTD study in PFTR | 04 |
| 5. | Kinetics study in Batch enzyme reactor | 04 |
| 6. | Heterogeneous reaction kinetics study in catalytic reactor | 04 |
| 7. | Heterogeneous reaction kinetics study in catalytic fluidized bed reactor | 04 |
| 8. | Kinetics study in Annular UV photo reactor. | 04 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering Kinetics - 3rd Edition | J. M. Smith | McGraw-Hill (1990) |
| Chemical Reaction Engineering - 3rd Edition | O. Levenspiel | John Wiley (1998) |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical and Catalytic Reaction Engineering | J. J. Carberry | McGraw Hill, New York, 1976. |
| Elements of Chemical Reaction Engineering | H. Scott Fogler | 3rd Edition, John Wiley & Sons (Asia) pvt. Ltd. |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103/108/103108097/
- https://nptel.ac.in/courses/103/101/103101141/
- https://nptel.ac.in/courses/103/102/103102012/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration.
- Faculty Evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of practical which will be evaluated out of 10 for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral performance of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

| SECH4211 | CHEMICAL REACTION KINETICS – II |
|---|---|
| CO 1 | Demonstrate basics of non-ideality. |
| CO 2 | Design alternatives to carry out reactions in real reactors. |
| CO 3 | Assess the progressive conversion model and shrinking core model for explaining the fluid particle reaction. |
| CO 4 | Illustrate the principles and mechanism involved in heterogeneous catalysis and analyze the data of heterogeneous catalytic reactions. |
| CO 5 | Identify the rate controlling mechanisms in heterogeneous catalysis and their rate determinations. |

**Mapping of CO with PO**

| SECH4211 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 2 | 3 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 3 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 4 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 5 | 2 | 1 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |

**Mapping of CO with PSO**

| SECH4211 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 2 | 2 | |
| CO 2 | 2 | 2 | |
| CO 3 | 2 | 2 | |
| CO 4 | 2 | 2 | |
| CO 5 | 2 | 2 | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Non-Ideal Flow | 1,2 |
| 2 | Heterogeneous Reactions: Introduction | 1,2 |
| 3 | Fluid-Fluid Systems | 1,2,4 |
| 4 | Fluid-Particle Systems | 1,2,4 |
| 5 | Catalysis | 1,2 |
| 6 | Solid-Catalyzed Reactions: Kinetics and Catalytic Reactors | 1,2,4 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4220
Course Name: Process Modeling and Simulation
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | Practical | | Tutorial | | |
| Theory | Practical | Tutorial | Credit | CE | ESE | CE | ESE | CE | ESE | Total |
| 02 | 02 | -- | 03 | 40 | 60 | 40 | 60 | -- | -- | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- understand the basic principles of process modelling & simulation.
- apply the concepts of modelling and simulation to develop models of chemical engineering systems.

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | **Process Analysis and its Basic Principles** Description of Systems, Subsystems, Scientific Methods, System Parameters, Process Analysis and Simulation | 04 | 10 |
| 2. | **Introduction to Simulation Tools** | 03 | 8 |
| 3. | **Mathematical Models and their Classification** Models Based on Transport Phenomena Principles, Alternate Classification of Models, Population Balance, Stochastic, and Empirical Models, Unit Models | 05 | 17 |
| 4. | **Models of Heat Transfer Equipment** Development of Detailed Mathematical Models of Evaporators, Use of Newton Raphson Method for Solving Evaporator Problems | 03 | 15 |
| 5. | **Models of Separation Processes** Separation of Multi-Components Mixtures by Use of a Single Equilibrium Stage, Flash Calculation Under Isothermal and Adiabatic Conditions. Tridiagonal Formulation of Component Material Balances and Equilibrium Relationships for Distillation, Absorption and Extraction of Multi-Components. Thiele and Geddes Method, Plus θ-method and $k_b$ method, models of Absorbers, Strippers and Extractors | 07 | 25 |
| 6. | **Models of Reactors** Classification of Fixed Bed Reactor Models, One Dimensional and Two-Dimensional Fixed Bed Reactor Models, Fluidized Bed Reactor Models, Bioreactor Models | 08 | 25 |
| | **TOTAL** | **30** | **100** |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction to ASPEN Plus | 02 |
| 2. | Thermodynamic model in ASPEN Plus | 04 |
| 3. | Steady State simulation in ASPEN Plus | 02 |
| 4. | Rigorous modelling Example-01 | 02 |
| 5. | Rigorous modelling Example-02 | 04 |
| 6. | Rigorous modelling Example-03 | 04 |
| 7. | Rigorous modelling Example-04 | 02 |
| 8. | Reactor Modelling Example -01 | 02 |
| 9. | Reactor Modelling Example -02 | 04 |
| 10. | Reactor Modelling Example -03 | 04 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Process Plant Simulation | B. V. Babu | Oxford University Press |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Numerical methods for engineers | S. K. Gupta | New Age International Publishers Ltd., (1995) |
| Applied Mathematics and modelling for Chemical Engineers | R. G. Rice, D. D. Do | John Wiley & Sons (1995) |
| Transport Phenomena | R. B. Bird, W. E. Stewart, E. N. Lightfoot | John Wiley & Sons (2002) |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103/107/103107096/
- https://lecturenotes.in/notes/17696-note-for-simulation-and-modelling-sm-by-bohar-singh
- https://nptel.ac.in/courses/112107214/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Practical:**

- Continuous Evaluation consists of performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/drawing/test consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

**Course Outcome(s):**
After the completion of the course, the students will able to:

| SECH4220 | PROCESS MODELING AND SIMULATION |
|---|---|
| CO 1 | Apply basic principles of the cad software. |
| CO 2 | Perform product and process design and underlying thermodynamic and physical principles. |
| CO 3 | Calculate computer aided equipment design of various chemical equipment: evaporators, distillation columns, reactors, and adsorption columns. |
| CO 4 | Design dynamic simulation of different systems. |
| CO 5 | Simulate in various commercial design software and optimizers used in the field of chemical engineering. |

**Mapping of CO with PO**

| SECH4220 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 2 | 3 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 3 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 4 | 2 | 2 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |
| CO 5 | 2 | 1 | 2 | 2 | 1 | | 1 | | | 1 | 1 | |

**Mapping of CO with PSO**

| SECH4220 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 2 | 2 | |
| CO 2 | 2 | 2 | |
| CO 3 | 2 | 2 | |
| CO 4 | 2 | 2 | |
| CO 5 | 2 | 2 | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Process Analysis and its Basic Principles | 1,2,3 |
| 2 | Introduction to Simulation Tools | 1,2,3 |
| 3 | Mathematical Models and their Classification | 2,3,4 |
| 4 | Models of Heat Transfer Equipment | 3,4,5 |
| 5 | Models of Separation Processes | 3,4,5 |
| 6 | Models of Reactors | 3,4,5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4234
Course Name: Transport Phenomena
Prerequisite Course(s): SECH2330- Heat Transfer Operations
SECH2310- Fluid Flow Operations

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | 02 | 04 | 40 | 60 | -- | -- | 40 | 60 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- learn momentum, Heat and Mass Transfer are three basic transport processes in chemical engineering.
- understand mathematical modeling and analogical aspects of chemical process systems where these transport processes occur simultaneously.
- understand transport Phenomena also focuses on typical situations and thereby its complete understanding on axial as well as radial profiles.

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | **Analogies in Momentum, Heat and Mass Transfer** Introduction, Reynolds Analogy, Prandtl Taylor Analogy, Van Karman Analogy, Martinelli Analogy, Chilton Analogy | 04 | 15 |
| 2. | **Principles of Momentum & Overall Balances** Shell momentum balances and velocity distributions. Shell energy balances and temperature distributions. Shell mass balances and concentration distributions. | 06 | 20 |
| 3. | **Use of General Transport Equations** Equations of change and their use in momentum transport (isothermal) | 05 | 15 |
| 4. | **Turbulent transport** Comparisons of laminar and turbulent flows. Time-smoothed equations of change for incompressible fluids. | 04 | 10 |
| 5. | **Principles of Heat Transfer** Application ofShell balance and Equations of changes for temperature distributions in heat flow problems Heat conduction with various heatsources, Heatconduction withcooling fins, Temperaturedistribution for fully developed viscous flow, Heat transfer for non-Newtonian fluids, Unsteady stateheat transferin variousgeometries, Partialfreezing model, Chilling &Freezing ofbiological materials, Heattransfer with phase change. | 05 | 20 |
| 6. | **Principles of Mass Transfer** Application of Shell balance method and Equations of changes | 06 | 20 |

| | | | |
|---|---|---|---|
| | for mass transfer problems, Diffusivity, mass and molar transport by convection, Concentration distributions for isothermal and non-isothermal mixtures, Multi component systems with more than one independent variable and in turbulent flow convective mass transfer and correlation, inter phase mass transfer, Diffusion with chemical reaction, Transport across selectively permeable membrane and porous media. | | |
| | **TOTAL** | **30** | **100** |

**List of Tutorials:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Tutorial – 1 (Momentum Transfer) | 02 |
| 2. | Tutorial – 2 (Momentum Transfer) | 04 |
| 3. | Tutorial – 3 (Momentum Transfer) | 04 |
| 4. | Tutorial – 4 (Fluid Transfer) | 04 |
| 5. | Tutorial – 5 (Fluid Transfer) | 04 |
| 6. | Tutorial – 6 (Fluid Transfer) | 04 |
| 7. | Tutorial – 7 (Heat Transfer) | 04 |
| 8. | Tutorial – 8 (Heat Transfer) | 04 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Transport Phenomena | Bird R.B., Stewart W.E., Lightfoot E. N. | John Wiley & Sons, 2002. |
| Fundamentals of Momentum, Heat and Mass transfer | Welty, J.R., Wicks, C.W., Wilson, R.E. and Rorrer, G. | John Wiley & Sons. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Momentum Heat and Mass Transfer in Cintiniua. | Slattery J.C. | McGraw-Hill |
| Advanced Transport Phenomena. | Slattery J.C. | Cambridge University Press |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103/106/103106159/
- https://nptel.ac.in/courses/103/102/103102024/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Submission of Power point presentation which is to be presented by the students in a group of 3 which carries 10 marks of evaluation.
- End Semester Examination consists of 60 marks.

**Tutorial:**

- Continuous Evaluation consists of performance of tutorials which will be evaluated out of 10 marks for each tutorial and average of the same will be converted to 30 marks.
- MCQ based examination consists of 10 marks.
- Internal Viva consists of 10 marks.

**Course Outcome(s):**

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

| SECH4234 | TRANSPORT PHENOMENA |
|---|---|
| CO 1 | Interpret overall balances for conservation of momentum, energy and mass. |
| CO 2 | Recognize and apply analogies among momentum, heat and mass transfer. |
| CO 3 | Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration. |
| CO 4 | Utilize information obtained from solutions of the balance equations to obtain engineering quantities of interest. |

**Mapping of CO with PO**

| SECH4234 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | | | | | | | | 1 | | |
| CO 2 | 2 | 1 | 1 | | | | | | | | | |
| CO 3 | | 1 | | 1 | 1 | | | | | | | 1 |
| CO 4 | 1 | 1 | 1 | | 1 | | | | | | | |

**Mapping of CO with PSO**

| SECH4234 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | | |
| CO 2 | 1 | 1 | |
| CO 3 | | | |
| CO 4 | 2 | | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Analogies in Momentum, Heat and Mass Transfer | 1,2,4,5 |
| 2 | Principles of Momentum & Overall Balances | 1,2,4,5 |
| 3 | Use of General Transport Equations | 1,2,5 |
| 4 | Turbulent transport | 1,2,4 |
| 5 | Principles of Heat Transfer | 1,2,4,5 |
| 6 | Principles of Mass Transfer | 1,2,4,5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4240
Course Name: Industrial Automation
Prerequisite Course(s): SECH3310- Instrumentation & Process Control

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| -- | 02 | -- | 01 | -- | -- | 100 | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**

To help learners to
Understand architecture and components of industrial automation systems used in chemical plants.
Interface sensors/transmitters with control hardware.
Program basic logic and control strategies using PLC.
Develop simple SCADA interfaces for process visualization and supervision.
Perform experiments on automated chemical process loops (continuous & batch).
Troubleshoot basic automation issues in process context.

**List of Practicals:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Calibration of pressure gauge, temperature sensor | 02 |
| 2. | Measurement of temperature, pressure, level & flow in a process tank | 04 |
| 3. | control of pumps, valves, heaters, alarms using PLC for chemical process safety interlocks | 04 |
| 4. | PID control implementation in PLC for tank | 04 |
| 5. | Experiments on cascade control | 04 |
| 6. | Development of SCADA screens using software | 04 |
| 7. | Connecting PLC with SCADA; real-time monitoring & control of a process | 04 |
| 8. | Automation of a small chemical process (e.g., pH control in neutralization, temperature control in CSTR, | 04 |
| | **TOTAL** | **30** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Process Control | Stephanopoulos | Prentice Hall of India |
| Industrial Instrumentation | Donald .P. Eckman | John Wiley & Sons Inc, New York |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Process System Analysis & Control | Coughanower and Kappel | Mc-Graw Hill International |
| Process dynamics and control | Seborg, D.E.,Edgar, T.F | Wiley, NewYork |

**Web Material Link(s):**

- https://onlinecourses.nptel.ac.in/noc20

**Course Evaluation:**

**Practical:**

- Continuous Evaluation consist of performance of Practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 100mark.
- Practical performance/quiz/drawing/test of 50 marks during End Semester Exam.
- Viva/Oral presentation consists of 50 marks during End Semester Exam.

**Course Outcome(s):**

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

| **SECH4240** | **INDUSTRIAL AUTOMATION** |
|---|---|
| CO 1 | Identify, select, calibrate, and interface common process instruments. |
| CO 2 | Develop and implement basic ladder logic programs on PLCs to perform digital control tasks. |
| CO 3 | Apply PID control algorithms in PLC environment to regulate key process variables. |
| CO 4 | Implement advanced control strategies. |
| CO 5 | Perform troubleshooting of automation hardware/software issues. |

**Mapping of CO with PO**

| **SECH4240** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | | | | | | | | 1 | | |
| CO 2 | 2 | 1 | 1 | | | | | | | | | |
| CO 3 | | 1 | | 1 | 1 | | | | | | | 1 |
| CO 4 | 1 | 1 | 1 | | 1 | | | | | | | |
| CO 5 | 2 | 1 | 1 | | | | | | | | | |

**Mapping of CO with PSO**

| **SECH4240** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | | | |
| CO 2 | 1 | 1 | |
| CO 3 | | | |
| CO 4 | 2 | | |
| CO 5 | 1 | 1 | |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4250
Course Name: Industrial Waste Management Control

Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 02 | -- | -- | 02 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- give an overview of various methods of process modeling, different computational techniques for simulation.
- focus on the techniques, rather than specific applications so that the student can take up modeling and simulation challenges in his profession.

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | **Introduction**<br>Industrial waste, types of industrial waste, sources of industrial waste, characteristics of industrial waste, effects of waste on sewage treatment plants, waste reduction alternatives. | 05 | 20 |
| 2. | **Wastewater Characteristics**<br>Development of Steady State and Dynamic Lumped and Distributed Parameter Models Based on First Principles. Analysis of Ill-conditioned Systems. Models with Stiff Differential Equations. | 05 | 20 |
| 3. | **Wastewater Treatment Methods**<br>Preliminary or primary treatment of wastewater: Different physical and chemical treatments, Secondary treatment: Aerobic and anaerobic treatment, BOD, COD, MLSS, MLVSS, Attached growth, Suspended growth, Activated sludge growth process, Upflow anaerobic sludge blanket reactor, trickling filter, Rotating biological contactor etc. Various post treatment methods such as lagoon, stabilizing pond, facultative pond etc. | 20 | 20 |
| 4. | **Sludge Treatment and Disposal**<br>Sequence of operations for sludge treatment: Concentration, Digestion, Conditioning, Dewatering, Oxidation. | 08 | 20 |
| 5. | **Solid Waste Treatment**<br>Definition, Types of solid waste, storage and handling of solid waste, Different treatment of solid waste, E-waste treatment, Hazardous waste management | 07 | 20 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Process Modeling, Simulation and Control for Chemical Engineers (4th edition) | Tchobanoglous G. , Burton F.L., Stensel H.D | Metcalf & Eddy Inc. 2003. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Water and Wastewater Technology, 6th Ed. | Hammer M.J., and Hammer M.J. Jr | Prentice Hall Inc., 2008. |
| Managing Industrial Pollution | Bhatia, S.C. | Macmillan India Ltd., 2003. |
| Environment Pollution Control Engineering | Rao C. S. | NewAge International, 2nd Ed. 2011 |

**Web Material Link(s):**

- https://nptel.ac.in/courses/105105350
- https://nptel.ac.in/courses/105106056

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration and the average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

After the completion of the course, the students will able to:

| SECH4250 | INDUSTRIAL WASTE MANAGEMENT CONTROL |
|---|---|
| CO 1 | Recognize different types of industrial waste and their characteristics. |
| CO 2 | Analyze the role of microorganisms and its importance in biological treatment of wastewater. |
| CO 3 | Compare different secondary wastewater treatment methods and solve the problems related to wastewater treatment methods. |
| CO 4 | Design different types of wastewater treatment equipment and reactors. |

**Mapping of CO with PO**

| SECH4250 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | | 3 | 3 | | | | | | | 3 |
| CO 2 | 1 | 3 | | 3 | 3 | | | | | | | |
| CO 3 | 1 | 3 | | 3 | 3 | | | | | | | |
| CO 4 | 1 | 3 | | 3 | 3 | | | | | | 3 | |

**Mapping of CO with PSO**

| SECH4250 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | 3 | 2 |
| CO 2 | | | 2 |
| CO 3 | | 2 | 2 |
| CO 4 | | 1 | 2 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Introduction | 1,2 |
| 2 | Wastewater Characteristics | 1,2,3 |
| 3 | Wastewater Treatment Methods | 3,4,5 |
| 4 | Sludge Treatment and Disposal | 3,4,5 |
| 5 | Solid Waste Treatment | 2,3,4 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4950
Course Name: Project/Summer Internship
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| -- | 05 | -- | 05 | -- | -- | 100 | | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Outline of the Course:**

**Project**

- The project will be aligned with the aims of the engineering programme and its areas of specialization and shall be based on the recent trends in technology.
- The student shall carry out a comprehensive project at relevant academic / R&D / industrial organization.
- The student is required to submit a project report based on the work carried out.

**Training**

- The aim of this course is to use the internship experience to enable students to develop their engineering skills and practices.
- The student will be placed in industry/organization for 12 to 18 weeks and assessed for academic credit.
- The students may select industry on their own or one which is offered by institute.
- Students are expected to experience a real-life engineering workplace and understand how their engineering and professional skills can be utilized in industry.
- The student is required to submit a project report based on the work carried out.

**Course Outcome(s):**

After the completion of the course, the students will able to:

| **SECH4950** | **PROJECT / SUMMER INTERNSHIP** |
|---|---|
| CO 1 | Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study. |
| CO 2 | Determine the challenges and future potential for his/her internship organization in particular and the sector in general. |
| CO 3 | Test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period. |
| CO 4 | Apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship organization. |
| CO 5 | Analyze the functioning of internship organization and recommend changes for improvement in processes. |

**Mapping of CO with PO**

| **SECH4930** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 |
| CO 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 |
| CO 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 |
| CO 4 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 |
| CO 5 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 |

**Mapping of CO with PSO**

| **SECH4930** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 3 | 3 | 3 |
| CO 2 | 3 | 3 | 3 |
| CO 3 | 3 | 3 | 3 |
| CO 4 | 3 | 3 | 3 |
| CO 5 | 3 | 3 | 3 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Content** | **RBT Level** |
|---|---|
| Project/Summer Internship | 1,2,3,4,5 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4550
Course Name: Chemical System Modelling
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | -- | -- | 03 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- give an overview of various methods of process modeling, different computational techniques for simulation.
- focus on the techniques, rather than specific applications so that the student can take up modeling and simulation challenges in his profession.

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 6. | **Introduction to Process Modeling** Systematic Approach to Model Building, Classification of Models. Conservation Principles, Thermodynamic Principles of Process Systems | 05 | 10 |
| 7. | **Models based on First Principle** Development of Steady State and Dynamic Lumped and Distributed Parameter Models Based on First Principles. Analysis of Ill-conditioned Systems. Models with Stiff Differential Equations. | 08 | 20 |
| 8. | **Development of Grey Box Models** Empirical model building. Statistical model calibration and validation. Examples. Introduction to population balance models, multi-scale modeling. | 09 | 20 |
| 9. | **Solution Strategies for Lumped Parameter Models and Stiff Differential Equations** Solution Methods for Initial Value and Boundary Value Problems. Euler's Method. R-k Methods, Shooting Method, Finite Difference Methods – Predictor Corrector Methods. | 10 | 20 |
| 10. | **Solution Strategies for Distributed Parameter Models** Solving parabolic, elliptic and hyperbolic partial differential equations. Introduction to finite element and finite volume methods. | 10 | 20 |
| 11. | **Solving Problems using MATLAB** | 03 | 10 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Process Modeling, Simulation and Control for | W.L. Luyben | McGraw Hill Book Co., New York |

| | | |
|---|---|---|
| Chemical Engineers (2nd edition) | | (1990) |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Mathematical Methods in Chemical Engineering (2nd edition) | Jensen V.G., Jeffrey's G.V. | Academic Press, London(1978) |
| Computational Methods for Process Simulation (2nd edition) | W. F. Ramirez | Butterworths (1997) |
| Chemical Process Modelling and Computer Simulation (2nd edition) | Amiya K. Jana | Prentice Hall of India (2011) |
| Applied Numerical Analysis using MATLAB (2nd edition) | Laurene V. Fausett | Pearson (2009) |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103101142/
- https://lecturenotes.in/subject/383/simulation-and-modelling-sm

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration and the average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

After the completion of the course, the students will able to:

| SECH4550 | CHEMICAL SYSTEM MODELLING |
|---|---|
| CO 1 | Develop process models based on conservation principles and process data. |
| CO 2 | Correlate computational techniques to solve process models. |
| CO 3 | Apply simulation tools for real problem solving. |
| CO 4 | Develop mathematical models for various chemical processes. |

**Mapping of CO with PO**

| SECH4550 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | | 3 | 3 | | | | | | | 3 |
| CO 2 | 1 | 3 | | 3 | 3 | | | | | | | |
| CO 3 | 1 | 3 | | 3 | 3 | | | | | | | |
| CO 4 | 1 | 3 | | 3 | 3 | | | | | | 3 | |

**Mapping of CO with PSO**

| SECH4550 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 1 | 3 | 2 |
| CO 2 | | | 2 |
| CO 3 | | 2 | 2 |
| CO 4 | | 1 | 2 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Introduction to Process Modeling | 1,2 |
| 2 | Models based on First Principle | 1,2,3 |
| 3 | Development of Grey Box Models | 3,4,5 |
| 4 | Solution Strategies for Lumped Parameter Models and Stiff Differential Equations | 3,4,5 |
| 5 | Solution Strategies for Distributed Parameter Models | 2,3,4 |
| 6 | Solving Problems using MATLAB | 3,4,5 |

**P P Savani University**
**School of Engineering**
**Department of Chemical Engineering**

Course Code: SECH4560
Course Name: Quality Control and Quality Assurance – Instrumentation and Validation Process
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | -- | -- | 03 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to
- understand the importance of quality
- learn about ISO management systems
- know the tools for quality improvement
- analysed the issues in quality
- learn the importance of quality evaluation of pharmaceuticals
- understand the concept of stability testing of drug and drug substances
- practice statistical approaches for quality

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | **Introduction**<br>Concept and evolution and Scopes of Quality Control and Quality Assurance, Good Laboratory Practice, GMP, Overview of ICH Guidelines - QSEM, with special emphasis on Q series guidelines. Good Laboratory Practices: Scope of GLP, Definitions, Quality Assurance Unit, Protocol for Conduct of Non-Clinical Testing, Control on Animal House, Report Preparation and Documentation. CPCSEA Guidelines | 07 | 14 |
| 2. | **Inspection Convention**<br>cGMP Guidelines according to schedule M, USFDA (inclusive of CDER andCBER) Pharmaceutical InspectionConvention(PIC), WHOand EMEA Covering: Organization and Personnel Responsibilities, Training, Hygiene and Personal Records, Drug Industry Location, | 07 | 18 |

| | | | |
|---|---|---|---|
| | Design, Construction and Plant Layout, Maintenance, Sanitation, Environmental Control, Utilities and Maintenance ofSterile Areas, Controlof Contaminationand Good Warehousing Practice. | | |
| 3. | **Quality Control**<br>Analysis of Raw Materials, Finished Products, Packaging Materials, In Process Quality Control (IPQC), Developing Specification (Ich Q6 And Q3), Purchase Specifications and Maintenance of Stores for Raw Materials. In Process Quality Control and Finished Products Quality Control for Following Dosage Forms in Pharma Industry according to Indian, US and British Pharmacopoeias: **Table**ts, Capsules, Ointments, Suppositories, Creams,Parenteral, Ophthalmic andSurgicalProducts (How to ReferPharmaCopoeias). | 08 | 18 |
| 4. | **Documentation**<br>Documentation in Pharmaceutical Industry: Three tier documentation,Policy, Procedures and Work Instructions, and Records (Formats), Basic Principles- How to Maintain, Retention and Retrieval etc. Standard Operating Procedures (How to write), Master Batch Record, Batch Manufacturing Record, Quality Audit Plan and Reports. Specification and Test Procedures, Protocols and Reports. Distribution Records. Electronic Data Handling. Concepts of Controlled and Uncontrolled Documents. Submission documents for regulators DMFs, as Common Technical Document andElectronic Common Technical Documentation (CTD, eCTD). Concept of regulated andnon regulated markets. | 12 | 25 |
| 5. | **Manufacturing Operations and Controls**<br>Sanitation of Manufacturing Premises, Mix-Ups and Cross Contamination, Processing of Intermediates and Bulk Products, Packaging Operations, IPQC, Release of Finished Product, Process Deviations, Charge-In of Components, Time Limitations on Production, Drug Product Inspection, Expiry Date Calculation, Calculation of Yields, Production Record Review, Change Control, Sterile Products, Aseptic Process Control, Packaging, Reprocessing, Salvaging, Handling of Waste and Scrap Disposal. Introduction, Scope and Importance of Intellectual Property Rights. Concept of Trade Mark, Copyright and Patents. | 11 | 25 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Quality Assurance Guide by organization of Pharmaceutical Procedures of India | D H Shah | 3rdrevised edition, Volume I & II, Mumbai, 1996. |
| How to Practice GMP's | P P Sharma, | Vandana Publications, Agra, 1991. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I & II, 2nd edition | -- | WHO Publications, 1999 |
| Good laboratory Practice Regulations –, Volume 38, | Allen F. Hirsch | Marcel Dekker Series, 1989 |

**Web Material Link(s):**

- www.pharmaguide.com

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

After the completion of the course, the students will able to:

| **SECH4560** | **QUALITY CONTROL AND QUALITY ASSURANCE – INSTRUMENTATION AND VALIDATION PROCESS** |
|---|---|
| CO 1 | Analyze importance of quality control and quality assrance roles in process industries. |
| CO 2 | Discover about iso management systems and their applications for qc qa laboratories. |
| CO 3 | Execute tools for quality improvement in the research and development field. |
| CO 4 | Analyze issues in quality control and process. |
| CO 5 | Predict quality evaluation of various products generated by chemical process industries. |

**Mapping of CO with PO**

| **SECH4560** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | | 2 | 1 | 2 | | | | 3 | | 1 |
| CO 2 | | | 1 | | | 3 | | | | 3 | | 1 |
| CO 3 | 2 | 2 | 1 | 3 | 1 | | | | | 3 | | 1 |
| CO 4 | 2 | 2 | 1 | 3 | 1 | | | | | 3 | | 1 |
| CO 5 | 2 | 2 | 1 | 3 | 1 | | | | | 3 | | 1 |

**Mapping of CO with PSO**

| **SECH4560** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 3 | 1 | 1 |
| CO 2 | 3 | 1 | 1 |
| CO 3 | 3 | 1 | 1 |
| CO 4 | 3 | 1 | 1 |
| CO 5 | 3 | 1 | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Introduction | 1,2 |
| 2 | Inspection Convention | 1,2 |
| 3 | Quality Control | 1,2 |
| 4 | Documentation | 1,2 |
| 5 | Manufacturing Operations and Controls | 1,2 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4570
Course Name: Membrane Technology
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | -- | -- | 03 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- enable to understand membrane-based separation problems by acquiring in-depth knowledge in the area of membrane separation mechanisms, transport models, membrane materials and modules.
- focus particularly on various applications of membrane science and technology.

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | **Rate Governed and Equilibrium Membrane Separation Processes** Fundamentals, Types of Membranes, Modules, Flow Patterns, Preparation and Characterization of Membranes, Melt Pressing, Film Stretching, Sol-gel Peptization, Interfacial Polymerization etc. Measurement of Pore Size and Solute Rejection Properties | 06 | 15 |
| 2. | **Reverse Osmosis** Design and Operating Parameters, Various Transport Models, Kedem-katchalsky Model, Spiegler-kedem Model, Solution-diffusion Model, Concentration Polarization and Flux Decline, Design of an RO module, Forward Osmosis | 06 | 15 |
| 3. | **Nanofiltration** Transport Mechanism in NF Membranes, Parameters affecting the Performance of NF Membranes, Fouling Model, Determination of Various Resistances | 06 | 10 |
| 4. | **Ultrafiltration** Factors Affecting Performance of Ultrafiltration, Resistance Model, Gel Polarization Model, Fouling and Flux Decline, Micellar-Enhanced Ultrafiltration, Affinity Ultrafiltration, Microfiltration Advances | 05 | 10 |
| 5. | **Membrane Gas Separation** Membranes for Gas Separation, Fundamental Mechanism of Gas Transport, Knudsen Diffusion, Molecular Sieving, Solution Diffusion, Dual Sorption Model, Factors Affecting Gas Permeation, Complete Mixing Model, Solution of Equations, Equations for Multicomponent Mixtures, Cross - Flow Model, Countercurrent Model, Applications | 07 | 20 |
| 6. | **Pervaporation** | 05 | 10 |

| | | | |
|---|---|---|---|
| | Mass Transfer and Thermodynamics Aspects of Pervaporation, Temperature Drop at Membrane Interface | | |
| 7. | **Dialysis**<br>Principle of Dialysis, Dialysis Systems, Mass Transfer in Dialysis, Modeling of Solute Transport in Hemodialyzer, Advantages of Diffusion Dialysis, Application of Diffusion Dialysis, Electrodialysis | 06 | 10 |
| 8. | **Membrane Reactor**<br>Membrane Bioreactor, Membrane Distillation | 04 | 10 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Membrane technology and applications | Baker, R.W. | 2nd ed., John Wiley 2004 |
| Membrane separation Processes | K Nath | Prentice Hall of India, New Delhi |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Basic Principles of Membrane Separation | Mudler J | (2nd Edition), Springer |

**Web Material Link(s):**

https://nptel.ac.in/courses/103105121/

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Submission of power point presentation which is to be presented by the students in a group of 3 which carries 10 marks of evaluation.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

After the completion of the course, the students will able to:

| SECH4570 | MEMBRANE TECHNOLOGY |
|---|---|
| CO 1 | Identify and describe the main unit operations associated with membrane technology. |
| CO 2 | Describe the main industrial applications of membrane technology. |
| CO 3 | Calculate mean flux, selectivity and membrane area for the different membrane processes. |
| CO 4 | Employ membrane technology knowledge to discuss recent journal articles in the membrane field and compare the with similar separation processes. |

**Mapping of CO with PO**

| SECH4570 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | | | | 2 | | | | 2 | | 2 |
| CO 2 | 1 | 1 | | | | 3 | 1 | | | 2 | | 2 |
| CO 3 | 3 | 2 | | | | 2 | 3 | | | 2 | | 2 |
| CO 4 | 2 | 2 | | | | 3 | 2 | | | 3 | | 2 |

**Mapping of CO with PSO**

| SECH4570 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 2 | 2 | 1 |

| | | | |
|---|---|---|---|
| CO 2 | 2 | 1 | 2 |
| CO 3 | 3 | 2 | 3 |
| CO 4 | 1 | 3 | 3 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| **Module No** | **Content** | **RBT Level** |
|---|---|---|
| 1 | Rate Governed and Equilibrium Membrane Separation Processes | 1,2,4 |
| 2 | Reverse Osmosis | 1,2 |
| 3 | Nanofiltration | 1,2 |
| 4 | Ultrafiltration | 1,2 |
| 5 | Membrane Gas Separation | 1,2 |
| 6 | Pervaporation | 1,2 |
| 7 | Dialysis | 1,2 |
| 8 | Membrane Reactor | 1,2 |

**P P Savani University**
**School of Engineering**

**Department of Chemical Engineering**

Course Code: SECH4580
Course Name: Industrial Health & Safety Engineering
Prerequisite Course(s): --

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 03 | -- | -- | 03 | 40 | 60 | -- | -- | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to

- provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
- understand the various hazards and prevention in commissioning stage of industry.
- recognize and identify the safe operation of equipment in process industry.
- plan and trained for emergency planning in a process industry.
- get fundamental knowledge on safe storage of chemicals.
- understand mathematical modeling and analogical aspects of chemical process systems where these transport processes occur simultaneously.
- transport Phenomena also focuses on typical situations and thereby its complete understanding on axial as well as radial profiles.

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | **Hazard, Risk Issues, and Hazard Assessment**<br>Introduction, Hazard assessment, Hazard operability studies (HAZOP, HAZAN), Fire triangle, OSHA standards | 03 | 05 |
| 2. | **Safety in Process Design**<br>Design Process, Conceptual Design and Detail Design, Assessment, Inherently Safer Design Chemical Reactor, Types, Batch Reactors, Reaction Hazard Evaluation, Assessment, Reactor Safety, Operating Conditions, Unit Operations and Equipment, Utilities | 05 | 08 |
| 3. | **Safety in Pressure System Design**<br>Pressure System, Pressure Vessel Design, Standards and Codes- Pipe Works and Valves - Heat Exchangers - Process Machinery- Over Pressure Protection, Pressure Relief Devices and Design, Fire Relief, Vacuum and Thermal Relief, Special Situations, Disposal- Flare and Vent Systems Failures InPressure System. | 06 | 17 |
| 4. | **Plant Commissioning**<br>Commissioning Phases and Organization, Pre-Commissioning Documents, Process Commissioning, Commissioning Problems, Post Commissioning Documentation | 04 | 10 |
| 5. | **Plant Inspection** | 05 | 10 |

| | | | |
|---|---|---|---|
| | Plant Inspection, Pressure Vessel, Pressure Piping System, Non-Destructive Testing, Pressure Testing, Leak Testing and Monitoring - Plant Monitoring, Performance Monitoring, Condition, Vibration, Corrosion, Acoustic Emission-Pipe Line Inspection | | |
| 6. | **Plant Maintenance, Modification and Emergency Planning** Management of Maintenance, Hazards - Preparation for Maintenance, Isolation, Purging, Cleaning, Confined Spaces, Permit System - Maintenance Equipment - Hot Works - Tank Cleaning, Repair and Demolition - Online Repairs - Maintenance of Protective Devices - Modification of Plant, Problem-Controls of Modifications. | 07 | 10 |
| 7. | **Storages and Transportation** General consideration, petroleum product storages, storage tanks and vessel- storages layout segregation, separating distance. LPG storages, pressure storages, layout, instrumentation, vaporizers, refrigerated storages-LNG Storages, Hydrogen Storages, Toxic Storages, Chlorine Storages, Ammonia Storages. Chemical Storages- Underground Storages- Loading and Unloading Facilities- Drum and Cylinder Storage- ware House, Storage Hazard Assessment of LPG and LNG Hazards during Transportation – Pipeline Transport. | 07 | 20 |
| 8. | **Plant Operations** Application ofShell BalanceMethod andEquations ofChanges for Mass Transfer Problems, Diffusivity, Mass and Molar Transport By Convection, Concentration Distributions for Isothermal and Non-Isothermal Mixtures, Multi-component Systemswith more than one Independent Variable and in Turbulent Flow Convective Mass Transfer and Correlation, Inter Phase Mass Transfer, Diffusion with Chemical Reaction, Transport Across Selectively Permeable Membrane and Porous Media | 08 | 20 |
| | **TOTAL** | **45** | **100** |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Safety and Accident Prevention in Chemical Operations. | Fawcett, H.h. and Wood | Wiley inters, Second Edition. |
| High Risk Safety Technology. | Green, A.E. | John Wiley & Sons. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Loss Prevention in Process Industries. | Lees, F.P | Butterworths and Company |
| Guidelines for Chemical Process Quantitative Risk Analysis | -- | AICHE, 2000 |

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

**Course Outcome(s):**

After the completion of the course, the students will able to:

| SECH4580 | INDUSTRIAL HEALTH & SAFETY ENGINEERING |
|---|---|
| CO 1 | Analyze the effect of release of toxic substances in process industries. |
| CO 2 | Anticipate the industrial laws, regulations and source models. used for prediction of health and safety measures. |
| CO 3 | Apply the methods of prevention of fire and explosions by various fire fighting aids. |
| CO 4 | Distinguish the relief and its sizing methods used for safety precaution. |
| CO 5 | Evaluate the methods of hazard identification and preventive actions. |

**Mapping of CO with PO**

| SECH4580 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | | | | 2 | 1 | | 3 | 1 | 2 | 1 | 2 | |
| CO 2 | 1 | | | 1 | 1 | | | 1 | 2 | 3 | 2 | |
| CO 3 | | | | 1 | | | | 1 | 3 | 2 | 1 | |
| CO 4 | | | | 1 | 1 | | | | 1 | 1 | 1 | |
| CO 5 | | | | 1 | | | | | | 2 | | |

**Mapping of CO with PSO**

| SECH4580 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO 1 | 3 | 0 | 3 |
| CO 2 | | | 3 |
| CO 3 | 3 | | 1 |
| CO 4 | | | |
| CO 5 | | | 1 |

Level of Bloom's Revised Bloom's Taxonomy in Assessment

| | | |
|---|---|---|
| 1: Remember | 2: Understand | 3: Apply |
| 4: Analyze | 5: Evaluate | 6: Create |

| Module No | Content | RBT Level |
|---|---|---|
| 1 | Hazard, Risk Issues, and Hazard Assessment | 1,2 |
| 2 | Safety in Process Design | 1,2 |
| 3 | Safety in Pressure System Design | 1,2 |
| 4 | Plant Commissioning | 1,2 |
| 5 | Plant Inspection | 1,2 |
| 6 | Plant Maintenance, Modification and Emergency Planning | 1,2 |
| 7 | Storages and Transportation | 1,2 |
| 8 | Plant Operations | 1,2 |



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