# Syllabus Book

# B. Tech.
# (Chemical Engineering)

**P P Savani University**

School of Engineering

Effective From: 2018-19

Authored by: P P Savani University

# CONTENT

# FIRST YEAR B. TECH.

| P P SAVANI UNIVERSITY | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCHOOL OF ENGINEERING | | | | | | | | | | | | | | | |
| TEACHING & EXAMINATION SCHEME FOR B. TECH. CHEMICAL PROGRAMME AY:2018-19 | | | | | | | | | | | | | | | |
| **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** | SESH1010 | Elementary Mathematics for Engineers | SH | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 0 | 0 | 50 | 0 | 150 |
| | SECV1030 | Engineering Mechanics | CV | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SEME1020 | Engineering Workshop | ME | 0 | 2 | 0 | 2 | 1 | 0 | 0 | 50 | 0 | 0 | 0 | 50 |
| | SECE1010 | Basics of Computer & Programming | CE | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SESH1220 | Chemistry | SH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SEPD1010 | Academic English & Technical Writing | SEPD | 2 | 2 | 0 | 4 | 3 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SESH1050 | Solution to Societal Problems: A Community Service Approach | SH | 0 | 2 | 0 | 2 | 1 | 0 | 0 | 50 | 0 | 0 | 0 | 50 |
| | | | | | | **Total** | **28** | **22** | | | | | | | **850** |
| **2** | SESH1020 | Linear Algebra & Vector Calculus | SH | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 0 | 0 | 50 | 0 | 150 |
| | SEME1010 | Engineering Graphics | ME | 3 | 4 | 0 | 7 | 5 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |
| | SECV1060 | Basics of Engineering Sciences | CV | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECV1050 | Global Environmental Challenges & Management | CV | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECV1070 | Solid Mechanics | CV | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SEPD1020 | Communication Skills | SEPD | 2 | 2 | 0 | 4 | 3 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | | | | | | **Total** | **28** | **23** | | | | | | | **900** |

**P P Savani University**
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## Department of Civil Engineering

Course Code: SECV1030
Course Name: Engineering Mechanics

**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 | 2 | 0 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand different types of forces, systematic evaluation of effect of these forces, behavior of rigid and deformable bodies subjected to various types of forces, at the state of rest or motion of the particles.
- understand the fundamental principles, concepts and techniques, both theoretical and practical, with emphasis on the application of these to the solution of mechanics based suitable problems in all engineering.
- provide a strong foundation and formwork for more advanced study at every higher semester as the subject of engineering mechanics cuts broadly across all branches of engineering profession.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction**<br>Definition of rigid body, Deformable body, Scalar and Vector quantities, Fundamental principles of mechanics: Principle of transmissibility, Principle of superposition, Law of parallelogram of forces. | 02 | 6 |
| 2. | **Fundamental of Static**<br>Force, types of forces, Characteristics of a force, System of forces, Composition and resolution of forces.<br>**Concurrent Forces:** Resultant of coplanar concurrent force system by analytical and graphical method, Law of triangle of forces, Law of polygon of forces, Equilibrium conditions for coplanar concurrent forces.<br>**Non-Concurrent Forces:** Moments & couples, Characteristics of moment and couple, Varignon's theorem, Resultant of non-concurrent forces by analytical method, Equilibrium conditions of coplanar non-concurrent force system. | 10 | 20 |

| | | | |
|---|---|---|---|
| 3. | **Friction**<br>Theory of friction, Types of friction, Cone of friction, Angle of repose, Coefficient of friction, Friction on inclined plane, ladder friction, wedge friction, belt and rope friction. | 06 | 14 |
| 4. | **Beams and Support Reaction**<br>Types of loads, Types of supports, Types of beams, Determination of support reactions for different types of beam. | 04 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Truss**<br>Classification of Truss, Perfect and Imperfect truss Analysis of pin-jointed perfect truss using method of joints and Method of section | 06 | 14 |
| 2. | **Centroid And Centre of Gravity**<br>Centroid of lines, plane areas and volumes, Examples related to centroid of composite geometry, Pappus – Guldinus theorems. | 06 | 14 |
| 3. | **Moment of Inertia**<br>Parallel and Perpendicular axis theorems, Polar moment of inertia, Radius of gyration of areas, Examples related to moment of inertia of composite geometry. | 11 | 22 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Equilibrium of coplanar concurrent forces | 04 |
| 2. | To verify the law of parallelogram of forces | 04 |
| 3. | To verify the law of polygon of forces | 02 |
| 4. | To verify the lami's theorem | 02 |
| 5. | To study effect of friction on flat surface | 02 |
| 6. | To study effect of friction on angular surface | 02 |
| 7. | Equilibrium of parallel force system – simply supported beam | 02 |
| 8. | Solve tutorial on Truss, C.G & M.I | 10 |
| 9. | Draw sketches for different type of trusses | 02 |

**Text Books:**

| Title | Author/s | Publication |
|---|---|---|
| Engineering Mechanics (Statics & Dynamics) | Beer and Johnston | Tata McGraw Hill Education |
| Mechanics of Structure Vol. I & II | S. B. Junnarkar & H. J. Shah | Charotar Publication |
| Applied Mechanics | S. B. Junnarkar & H. J. Shah | Charotar Publication |

**Reference Books:**

| Title | Author/s | Publication |
|---|---|---|
| Engineering Mechanics, | Meriam and Karaige, | Wiley-India |
| Engineering Mechanics: Statics & Dynamics | S Rajsekaran | Vikas Publication |
| Engineering Mechanics of Solids | Popov E.P | Prentice Hall of India |

| | | |
|---|---|---|
| Engineering Mechanics Statics | J. L. Meriam, L G. Kraige. | John wiley & Son |
| Engineering Mechanics | S.S. Bhavikatti & K.G. Rajeshkarappa | New Age Publication |
| Engineering Mechanics | U.G. Jindal | Made easy Publication |
| Engineering Mechanics | K.L. Kumar | Tata McGraw Hill |
| Engineering Mechanics | R.C. Hibbeller | Pearson |

**Web Material Links:**

- http://nptel.ac.in/courses/122104014/
- http://nptel.ac.in/courses/112103108/

**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/tutorial which should be evaluated out of 10 for each practical/tutorial and average of the same will be converted to 10 marks.
- Internal viva component 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 completion of the course, the student will be able to understand

- Fundamental principles of mechanics, equilibrium, statics reactions and internal forces in statically determinate beams.
- Application of principles of statics to determine C.G and M.I of a different geometrical shape and Understand basics of friction and its importance.

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## Department of Civil Engineering

Course Code: SECV1050
Course Name: Global Environmental Challenges & Management

**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 | 0 | 0 | 0 | 0 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- Impart basic knowledge about environment and thereby developing an attitude of concern for environment.
- Create awareness on various environmental pollution aspects and issues.
- Give a comprehensive insight into natural resources, ecosystem and biodiversity.
- Educate the ways and means to protect the environment from various types of pollution.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Environment and Environmental Studies**<br>Terms related to environment, Necessity of Public awareness, Components of Environment, Relationship between the different components of Environment, Man and Environment relationship, Impact of technology on Environment, Objective, Principles, Importance, Scope of Environmental Education, | 02 | 4 |
| 2. | **Ecology and Ecosystems**<br>Introduction: Ecology- Objectives and Classification, Concept of an ecosystem- structure and functions of ecosystem Components of ecosystem- Producers, Consumers, Decomposers Bio-Geo- Chemical Cycles- Hydrologic Cycle, Energy Flow in Ecosystem, Food Chains, Food webs, Ecological Pyramids | 04 | 12 |
| 3. | **Natural Resources**<br>**Energy Recourses:** Renewable and Nonrenewable resources, exploitation and conservation, Role of individual in conservation of natural resources.<br>**Water resources:** Water sources- Surface and Ground water sources, Indian and global scenario. | 06 | 22 |

| | | | |
|---|---|---|---|
| | **Forest resources:** Definition, Ecological and Economic importance and benefits of forest, Indian scenario, Deforestation: causes and effects, remedial measures.<br>**Food resources:** Sources of food, Global and Indian food demand scenario, Limits of food production, Environmental effects of Agriculture. | | |
| 4. | **Global Environmental Challenges**<br>Climate change, Global warming and Greenhouse effect, Greenhouse gases, Acid rain, Depletion of ozone layer, Nuclear accidents and holocaust. | 03 | 12 |
| **Section II** | | | |
| Module No | Content | Hours | Weightage in % |
| 1. | **Environmental Pollution:**<br>Environmental degradation, Pollution, Sources of pollution, Types of environmental pollution.<br>**Water Pollution:** Water quality standards, Sources of water pollution: Industrial, Agricultural, Municipal, Classification of water pollutants, Effects of water pollutants, Eutrophication.<br>**Air Pollution:** Ambient air quality standards, Classification of air pollutants, Sources of common air pollutants, Natural and Anthropogenic sources, Effects of common air pollutants.<br>**Land Pollution:** Land uses, Land degradation: causes, effects and control, soil erosion.<br>**Noise Pollution:** Sound and Noise, Causes and Effects. Role of individual in the prevention of pollution. | 05 | 16 |
| 2. | **Effect of Human population on Environment**<br>**Human Population and Environment**:<br>Population Growth, World and Indian scenario, Population and Environmental Degradation, Malthusian theory, Optimum theory, Population explosion – Causes, Effects and Control.<br>**Urbanization:** Urban population growth and Environmental Problems. | 04 | 12 |
| 3. | **Environment Management:**<br>Disaster management, Solid waste management, Environment Impact assessment & ISO 14001 standards**.** | 06 | 22 |

**Text Book:**

| **Title** | **Author/s** | **Publication** |
|---|---|---|
| Environmental Studies | Anindita Basak | Pearson Publications |

**Reference Books:**

| **Title** | **Author/s** | **Publication** |
|---|---|---|
| Basics of Environmental Studies | Prof. N.S. Varandani | LAP - Lambert Academic Publishing |
| Basics of Environmental Studies | Dr. J. P. Sharma | University Science Press |
| Basics of Environmental Studies | U. K .Khare | Tata McGraw Hill Publications |

| | | |
|---|---|---|
| Environmental Studies | Anindita Basak | Pearson (India)Pvt. Ltd |
| Environmental Sciences | Daniel B Botkin & Edward A Keller | John Wiley & Sons Publications |
| Environmental Studies | Dr. Suresh K Dhameja | K Kataria & Sons Publications |
| Environmental Studies for Undergraduate Courses | Erach Bharucha | Universities Press (India) |
| Introduction to Environmental Engineering and Science | Gilbert Masters | Prentice-Hall Publication |
| Basics of Environmental Studies | S.G. Shah, Gopal N. Shah | Superior Publications |

**Web Material Links:**

- http://nptel.ac.in/courses/122102006/
- http://nptel.ac.in/courses/105104099/
- http://nptel.ac.in/courses/122102006/
- http://nptel.ac.in/courses/120108004
- http://nptel.ac.in/courses/105102089/
- http://nopr.niscair.res.in
- http://www.indiaenvironmentportal.org.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 understand

- multi-disciplinary nature of the environment, its components, and inter-relationship between man and environment.
- relevance and importance of the natural resources in the sustenance of life on earth and living standard.
- importance of ecosystem, biodiversity and natural bio geo chemical cycle.

**P P Savani University**
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## Department of Civil Engineering

Course Code: SECV1060
Course Name: Basics of Engineering Sciences

**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 | 2 | 0 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- study the fundamentals of mechanical systems.
- study and appreciate significance of mechanical engineering in different fields of engineering.
- carry out simple land survey and recent trends in civil engineering.
- understand components of building, building terminology and construction materials.
- understand the basic electrical component.
- understand the working principle, and applications of DC & AC machines.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Mechanical Engineering: An Overview**<br>Prime Movers - Meaning and Classification; Concepts of Thermodynamics: Definitions, systems and, Laws; Fuels Classification: Solid, liquid and gaseous their application. | 07 | 09 |
| 2. | **Basics of Steam Generators**<br>Boilers as per IBR, Classification, Functions of Mountings and Accessories. | LAB | 08 |
| 3. | **Civil Engineering: An Overview**<br>Introduction, Branches, Scope, Impact, Role of Civil Engineer.<br>**Building Materials And Construction:**<br>Introduction (types and properties) to construction materials like Stone, Bricks, Cement, Sand, Aggregates, Concrete, Steel. Classification of buildings, Types of loads acting on buildings, Building components and their functions, Type of foundation and importance, Symbols used in electrical layout, Symbols used for water supply, plumbing and sanitation. | 07 | 16 |

| | | | |
|---|---|---|---|
| 4. | **Basic Understanding Of Domestic Wiring**<br>Service mains, meter board and distribution board. Elementary discussion on Circuit protective devices: fuse and Miniature Circuit Breaker (MCB's). Electric shock, precautions against shock, Objectives of earthing, types of earthing; pipe and plate earthing, Residual current circuit breaker (RCCB)<br>**Electromagnetic Induction:** Definition Faradays Laws, Fleming's right hand rule, Lenz's Law, Statically and dynamically induced emf. Self-inductance, mutual inductance and coefficient of coupling. Energy stored in magnetic field. Force on current carrying conductor placed in a magnetic field, Fleming's left hand rule. | 08 | 17 |
| **Section II** | | | |
| Module No | Content | Hours | Weightage in % |
| 1. | **Motion and Power Transmission Devices**<br>Coupling, Clutch and Brakes: Classification Applications and differences, Drives: Classification Applications and differences | 08 | 09 |
| 2. | **Basics of I.C Engines**<br>Construction and working of 2 stroke & 4 stroke Petrol & Diesel engine, Difference between 2-stroke -4 stroke engine & petrol-diesel engine. | LAB | 08 |
| 3. | **Introduction yo Surveying And Leveling**<br>Introduction, Fundamental principles, Classification.<br>**Linear measurement:** Instrument used, Chaining on plane ground.<br>**Angular measurement:** Instrument used, Bearing, and Local attraction.<br>**Leveling:** Instrument used, Basic Terminologies, Types of leveling, and Method of leveling.<br>**Introduction to Modern Surveying Equipment's:** Total Station, GIS, GPS | 08 | 17 |
| 4. | **Electrical Circuits**<br>**Three phase:** Necessity and advantages of three phase systems, generation of three phase power. Definition of Phase sequence, balanced supply and balanced load. Relationship between line and phase values of balanced star and delta connections. Power in balanced three-phase circuits, measurement of power by two-wattmeter method. Determination power factor using wattmeter readings | 07 | 16 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | To understand the concepts of steam generators | 06 |
| 2. | To understand construction and working 2 –stroke & 4 –stroke Petrol Engines | 02 |
| 3. | To understand construction and working 2 –stroke & 4 –stroke Diesel Engines | 02 |
| 4. | Star Delta connections | 02 |
| 5. | Electrical safety demonstrations | 02 |
| 6. | Electrical wiring system | 02 |
| 7. | Verifying ohms law | 02 |
| 8. | Understanding three phase system | 02 |
| 9. | Unit Conversation exercise | 02 |
| 10. | Linear Measurement | 02 |
| 11. | Angular Measurement | 02 |
| 12. | Determine R.L of given point by Dumpy level without change point | 02 |
| 13. | Determine R.L of given point by Dumpy level with change point | 02 |

**Text Books:**

| Title | Author/s | Publication |
|---|---|---|
| Elements of Mechanical Engineering | S. B. Mathur, S. Domkundwar | Dhanpat Rai & Sons Publications |
| Elements of Mechanical Engineering | Sadhu Singh | S. Chand Publications |
| Elements of Civil Engineering | Anurag A. Kandya | Charotar Publication |
| Surveying Vol. I & II | Dr. B. C. Punamia | Laxmi Publication |
| Basic Electrical Engineering | V. N. Mittal and A. Mittal | Tata McGraw Hill |

**Reference Book:**

| Title | Author/s | Publication |
|---|---|---|
| Thermal Engineering | R. K. Rajput | Laxmi Publications |
| Basic Mechanical Engineering | T.S. Rajan | Wiley Eastern Ltd., 1996 |
| Surveying and Leveling | N. N. Basak | Tata McGraw Hill |
| Surveying Vol. I | S. K. Duggal | Tata McGraw Hill |
| Surveying and Leveling | R. Subramanian | Oxford University |
| Building Construction and Construction Material | G. S. Birdie and T. D. Ahuja | Dhanpat Rai Publishing |
| Engineering Material | S.C. Rangwala | Charotar Publication |
| Electrical Safety, Fire Safety Engineering | S. Rao | Khanna Publications |
| Electrical Estimating & costing | Surjit Singh | Dhanpat Rai & Co |

**Web Material Links:**

- http://nptel.ac.in/course.php
- http://nptel.ac.in/courses/105107157/
- http://nptel.ac.in/courses/105101087/
- http://nptel.ac.in/courses/105107121/
- http://nptel.ac.in/courses/105104100/
- http://nptel.ac.in/courses/108105053/

**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 should be evaluated out of 10 for each practical and average of the same will be converted to 10 marks.
- Internal viva component 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 completion of the course, the student will be able to

- know the principles and working of basic mechanical systems.
- comprehend importance of mechanical engineering in various fields of engineering.
- know about different civil engineering fields with an overview of building material, building construction and knowledge of surveying equipment in civil engineering.
- understand the importance of safety and the precaution to be taken while working with electrical equipment and accessories.
- understand concepts of three phase circuit.

**P P Savani University**
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## Department of Civil Engineering

Course Code: SECV1070
Course Name: Solid Mechanics
Prerequisite Course(s): Engineering Mechanics (SECV1030)

**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 | 2 | 0 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- the stresses developed under the application of force.
- the physical and mechanical properties of materials.
- behavior of structural element under the influence of various loads.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Introduction: Physical & Mechanical Properties of Material** Introduction, Classification of materials, Properties related to axial, bending, and torsional & shear loading, Toughness, hardness, Ductility, Brittleness. Proof stress, Factor of safety, Working stress, Load factor. | 04 | 8 |
| 2. | **Simple Stress and Strain** Definition of stress and strain, Tensile &compressive Stresses: Shear and complementary shear Strains, Linear, shear, lateral, thermal and volumetric. Hooke's law, Stresses and strain in bars of Varying, Tapering & Composite section, Principle of Superposition, Elastic Constants: Modulus of elasticity, Poisson's ratio, Bulk modulus, Shear modulus (Modulus of rigidity), Modulus of rigidity. | 06 | 12 |
| 3. | **Bending Stress and Strain** Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections( rectangular, I,T,C ) with respective centroid & parallel axes, bending stress distribution diagrams, moment of resistance & section modulus calculations. Concept, derivation of shear stress distribution formula, shear stress distribution diagrams | 08 | 20 |

| | | | |
|---|---|---|---|
| | for common symmetrical sections, maximum and average shears stresses, shear connection between flange & web. | | |
| 4. | **Principle Stress and Strain**<br>Two-dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress | 04 | 10 |
| **Section II** | | | |
| Module No | Content | Hours | Weightage in % |
| 1. | **Shear Force and Bending Moment**<br>Introduction, Types of loads, supports and beams, Shear force, Bending Moment, Sign conventions for shear force & Bending moment. Statically determinate beam, support reactions, SFD and BMD for concentrated load and uniformly distributed load, uniformly varying load, Point of contra-flexure. | 7 | 20 |
| 2. | **Column and Strut**<br>Introduction, Failure of a column and strut, Euler's column theory, Types of end conditions of columns, Columns with both ends hinged, Columns with one end fixed and the other hinged, Euler's formula and Equivalent length of a column, Slenderness Ratio, Limitations of Euler's Formula. | 10 | 18 |
| 3. | **Torsion**<br>Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity, Power Transmitted by shaft, Polar moment of Inertia. | 06 | 12 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Tensile test on Ductile materials (Mild steel, Copper, Wood) | 04 |
| 2. | Tensile test on Brittle Materials ( Cast iron, Concrete) | 04 |
| 3. | Compression test on Ductile materials (Mild steel, Copper, Wood) | 04 |
| 4. | Compression test on Brittle Materials ( Cast iron, Concrete) | 04 |
| 5. | Determination of hardness of metals (Brinell hardness test) | 02 |
| 6. | Determination of impact of metals (Izod/Charpy impact test) | 02 |
| 7. | Tutorials on Principle stress & Principle strain. | 04 |
| 8. | Tutorials on SFD & BMD. | 04 |
| 9. | Tutorials on Column & Strut. | 02 |

**Text Book:**

| Title | Author/s | Publication |
|---|---|---|
| Strength of Materials (SI Units) | R S Khurmi, N Khurmi | S. Chand& Company Pvt. Ltd. |

**Reference Books:**

| Title | Author/s | Publication |
|---|---|---|
| Strength of Materials (SI Units) | Er. R . K. Rajput | S. Chand & Company Pvt. Ltd. |
| Mechanics of Structure-Vol. I | Dr. H.J. Shah & S. B. Junarkar | Charotar Publishing House Pvt. Ltd. |
| Strength of materials | R. Subramanian | Oxford Publications |
| Strength of materials | S. Ramamrutham | Dhanpat Rai Publishing Company |

**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/tutorial which should be evaluated out of 10 for each practical/tutorial and average of the same will be converted to 10 marks.
- Internal viva component 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 completion of the course, the student will be able to

- Apply mathematical knowledge to calculate the deformation behavior of simple structure.
- Critically analyze problem and solve the problem related to mechanical elements and analyze the deformation behavior for different types of loads.
- Understand the different types of stresses and strains developed in the member subjected to axial, bending, shear & torsional effects.
- Understand the physical properties of materials.

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

## Department of Mechanical Engineering

Course Code: SEME1010
Course Name: Engineering Graphics

**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 | 4 | 0 | 5 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- to know conventions and the methods of engineering drawing.
- how to interpret engineering drawings using fundamental technical mathematics?
- how to construct basic and intermediate geometry?
- to improve their visualization skills so that they can apply these skills in developing new products.
- to improve their technical communication skill in the form of communicative drawings.
- to comprehend the theory of projection.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Introduction**<br>Importance of subject; Use of Drawing Instruments and accessories; BIS – SP – 46; Lettering, Dimensioning and lines; Representative Fraction; Types of Scales (Plain and Diagonal Scales); Construction of Polygons. | 03 | 05 |
| 2. | **Engineering Curves**<br>Classification and Application of Engineering Curves; Construction of Conics, Cycloidal Curves, Involutes and Spiral along with normal and tangent to Each. | 06 | 15 |
| 3. | **Principles of Projections**<br>Types of Projections; Introduction of Principle Planes of Projections.<br>**Projection of Points & Line:** Projection of Points in all four Quadrants; Projection of Lines with its inclination to one referral plane and two referral planes. | 14 | 30 |

| | | | |
|---|---|---|---|
| | **Projection of Plane:** Projection of Planes (Circular and Polygonal) with inclination to one referral plane and two referral planes; Concept of Auxiliary Projection Method. | | |
| Section II | | | |
| Module No | Content | Hours | Weightage in % |
| 1. | **Projection and Section of solids**<br>**Projection of solids:** polyhedral, prisms, pyramids, cylinder, cone, auxiliary projection method, one view, two view and three view drawings. Missing view, rules for selection of views; Sectional view, section plane perpendicular to the HP & VP and other various positions, true shape of sections. | 08 | 20 |
| 2. | **Orthographic projection**<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. | 07 | 18 |
| 3. | **Isometric projections and isometric drawing**<br>Isometric Scale, Conversion of orthographic views into isometric projection, isometric view or drawing. | 07 | 12 |

**List of Practical:**

| Sr No | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction sheet (dimensioning methods, different types of line, construction of different polygon, divide the line and angle in parts, use of stencil, lettering) | 08 |
| 2. | Plane scale and diagonal scale | 04 |
| 3. | Engineering curves | 08 |
| 4. | Projection of Points & Lines | 06 |
| 5. | Projection of Planes | 08 |
| 6. | Projection of solid & Section of solid | 10 |
| 7. | Orthographic projection | 08 |
| 8. | Isometric projection | 08 |

**Text Books:**

| 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 |

**Reference Books:**

| 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 |

**Web Material Links:**

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

**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 Consist of Performance of Practical/Tutorial which should be evaluated out of 10 for each practical/Tutorial and average of the same will be converted to 20 Marks.
- Internal Viva component 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 completion of the course, the student will be able to

- know and understand "Drawing is a language of Engineers."
- interpret general assembly technical drawing.
- create traditions and the strategies for Engineering Drawing.
- evaluate basic and intermediate geometry.
- apply the knowledge of principles of projections.
- develop their hallucination/imagination skills.
- enhance their technical communication skill in the form of talkative drawings.

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

## Department of Mechanical Engineering

Course Code: SEME1020
Course Name: Engineering Workshop

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 0 | 2 | 0 | 1 | 0 | 0 | 50 | 0 | 0 | 0 | 50 |

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:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Introduction**<br>Introduction to various shops / sections and workshop layouts, Safety norms to be followed in a workshop | - | - |
| 2. | **Fitting Shop**<br>Introduction of Fitting Shop; Safety; Making a Job As per Drawing including Marking and other Performing Operations. | - | - |
| 3. | **Carpentry and Drilling Shop**<br>Introduction of Carpentry Shop; Preparation of Job as per Drawing including Marking and other Performing Operations. | - | - |
| 4. | **Sheet Metal Shop**<br>Introduction of Sheet Metal Shop; Preparation of Job as per Drawing including Marking and other Performing Operations | - | - |
| 5. | **Smithy Shop**<br>Introduction of Sheet Metal Shop; Preparation of Job as per Drawing including Marking and other Performing Operations | - | - |
| 6. | **Introduction to Machine Tools**<br>Introduction and Demonstration of various machine tools like Lathe, Drilling, Grinding, Hack saw Cutting etc. | - | - |
| 7. | **Introduction to Welding & Plumbing**<br>Introduction and Demonstration of Welding process.<br>Introduction and Demonstration of Plumbing Shop. | - | - |

**List of Practical:**

| Sr No | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction and Demonstration of Safety Norms. Different Measuring Instruments | 02 |
| 2. | To Perform a Job of Fitting Shop | 06 |
| 3. | To Perform a Job of Carpentry Shop | 06 |
| 4. | To Perform a Job of Sheet metal Shop | 06 |
| 5. | To Perform a Job of Black Smithy Shop | 04 |
| 6. | Introduction and Demonstration of Grinding & Hacksaw Cutting Machine | 02 |
| 7. | Introduction and Demonstration of Plumbing Shop & welding process | 04 |

**Text Books:**

| Title | Author/s | Publication |
|---|---|---|
| Elements of Workshop Technology Vol. I | Hajra Chaudhary S.K | Media promoters & Publishers |
| Workshop Technology Vol. I and II | Raghuvanshi B. S. | Dhanpat Rai & Sons |

**Reference Books:**

| Title | Author/s | Publication |
|---|---|---|
| Workshop Technology Vol. I | W.A.J. Chapman | Edward Donald Publication |
| Workshop Practices | H S Bawa | Tata McGraw-Hill |
| Basic Machine Shop Practice Vol. I, II | Tejwani V.K | Tata McGraw-Hill |

**Web Material Links:**

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

**Course Evaluation:**

**Practical:**

- Continuous Evaluation Consist of Performance of Practical which should be evaluated out of 10 for each practical/Tutorial and average of the same will be converted to 30 Marks.
- Internal Viva component of 20 Marks.

**Course Outcome(s):**

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

- use various measuring instruments.
- know the importance of safety norms required in workshop.
- understand the application of various tools required for different operation.
- understand how to manufacture product from given raw material.
- come to know the use of machine tools, hand tools and power tools.

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**School of Engineering**

## Department of Mechanical Engineering

Course Code: SEME1040
Course Name: Concepts of Engineering 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 | |
| 2 | 2 | 0 | 3 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- to know conventions and the methods of engineering drawing.
- how to interpret engineering drawings using fundamental technical mathematics?
- how to construct basic and intermediate geometry?
- to improve their visualization skills so that they can apply these skills in developing new products.
- to improve their technical communication skill in the form of communicative drawings.
- to comprehend the theory of projection.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Introduction**<br>Importance of subject; Use of Drawing Instruments and accessories; BIS – SP – 46; Lettering, Dimensioning and lines; Representative Fraction; Types of Scales (Plain and Diagonal Scales); Construction of Polygons. | 07 | 25 |
| 2. | **Engineering Curves**<br>Classification and Application of Engineering Curves; Construction of Conics, Cycloidal Curves, Involutes and Spiral along with normal and tangent to Each. | 08 | 25 |

| Section II | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| | **Orthographic Projection**<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. | 08 | 25 |
| 1. | **Isometric Projections and Isometric Drawing**<br>Isometric Scale, Conversion of orthographic views into isometric projection, isometric view or drawing. | 07 | 25 |

**List of Practical:**

| Sr No | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction sheet (dimensioning methods, different types of line, construction of different polygon, divide the line and angle in parts, use of stencil, lettering, Plane scale and diagonal scale) | 10 |
| 2. | Engineering curves | 07 |
| 3. | Orthographic projection | 07 |
| 4. | Isometric projection | 06 |

**Text Books:**

| 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 |

**Reference Book:**

| 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 |

**Web Material Links:**

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

**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 Consist of Performance of Practical/Tutorial which should be evaluated out of 10 for each practical/Tutorial and average of the same will be converted to 10 Marks.
- Internal Viva component 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 completion of the course, the student will be able to

- know and understand "Drawing is a language of Engineers."
- interpret general assembly technical drawing.
- create traditions and the strategies for Engineering Drawing.
- evaluate basic and intermediate geometry.
- apply the knowledge of principles of projections.
- develop their hallucination/imagination skills.
- enhance their technical communication skill in the form of talkative drawings.

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**School of Engineering**

## Department of Computer Engineering

Course Code: SECE1010
Course Name: Basics of Computer and Programming
Prerequisite Course(s): Basic Knowledge of Computer

**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 | 2 | 0 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand basic components of computer system.
- identify appropriate approach to computational problems.
- develop logic building and problem-solving skill.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Introduction to computer and its architecture**<br>Introduction and Characteristics, Generation, Classification, Applications, Central Processing Unit and Memory, Communication between various units, processor speed, multiprocessor system | 05 | 10% |
| 2. | **Memory and various Input and Output devices**<br>Introduction to Memory, Memory hierarchy, Primary memory and its type, Secondary memory, Classification of Secondary memory, Various secondary storage devices and their functioning, their merits and demerits | 05 | 10% |
| 3. | **Operating Systems and Computer Languages**<br>Evolution of Operating System, types and functions of operating systems, Evolution and classification of programming language, Selection of a programming language | 04 | 08% |
| 4. | **Introduction to C Programming**<br>Features of C language, structure of C Program, Development of program, Algorithm and flowchart , Types of errors, debugging, tracing/stepwise execution of program, watching variables values in memory | 04 | 10% |

| | | | |
|---|---|---|---|
| 5. | **Constants, Variables and data Types**<br>Character Set, C tokens, Keyword, Constants and Variables, Data types - Declaration and initialization, User define type declarations typedef, enum, basic input and output operations, symbolic constants | 04 | 12% |
| | **Section II** | | |
| Module No | Content | Hours | Weightage in % |
| 6. | **Operators and Expression and Managing I/O operations**<br>Introduction to Operators and its types, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associatively; Introduction, reading a character, writing a character, formatted input, formatted output. | 05 | 10% |
| 7. | **Conditional statement and branching**<br>Decision Making & branching: Decision making with If & If ... Else statements, If - Else statements (Nested Ladder), The Switch & go-to statements, The turnery (?:) Operator Looping: The while statement, The break statement & The Do. While loop, The FOR loop, Jump within loops - Programs. | 07 | 16% |
| 8. | **Arrays and Strings**<br>Introduction to array, One dimensional array, Two dimensional arrays, Declaring and initializing string variables, Arithmetic operations on Characters, Putting strings together, Comparison of two strings, Basic String Handling Functions | 06 | 12% |
| 9. | **User-Defined Functions, Structure and Unions**<br>Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function<br>Introduction, Structure definition, declaring and initializing Structure variables, Accessing Structure members, Unions | 05 | 12% |

**List of Practical/Tutorial:**

| Sr No | Name of Practical/Tutorial | Hours |
|---|---|---|
| 1. | Introduction to Unix Commands | 04 |
| 2. | Word Processing, Spreadsheets and Presentation Exercises | 06 |
| 3. | Basic C Programs | 04 |
| 4. | Implementation in C for conditional statement and branching | 06 |
| 5. | Implementation in C for Array and Strings | 06 |
| 6. | Implementation in C for Functions, Structures and Unions | 04 |

**Text Books:**

| Title | Author/s | Publication |
|---|---|---|
| Programming in ANSI C | E. Balagurusamy | Tata McGraw Hill |
| Introduction to Computer Science | ITL Education Solutions Limited | Pearson Education |

**Reference Books:**

| Title | Author/s | Publication |
|---|---|---|
| Programming in C | Ashok Kamthane | Pearson |
| Let Us C | Yashavant P. Kanetkar | Tata McGraw Hill |
| Introduction to C Programming | Reema Thareja | Oxford Higher Education |
| Programming with C | Byron Gottfried | Tata McGraw Hill |

**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 Consist 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 component of 10 Marks.
- Practical performance/quiz/test of 15 Marks during End Semester Exam.
- Viva/Oral performance of 15 Marks during End Semester Exam.

**Course Outcome(s):**

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

- learn the fundamentals of programming.
- develop efficient programs with their own logic & capabilities.
- Understand the syntax and semantics of the 'C' language.

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**School of Engineering**

## Department of Computer Engineering

Course Code: SECE1020
Course Name: Introduction to Computer Programming
Prerequisite Course(s): Basic Knowledge of Computer

**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 | 4 | 0 | 5 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand basic components of computer system.
- identify appropriate approach to computational problems.
- develop logic building and problem solving skills.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Introduction to Computers**<br>Introduction, Central Processing Unit, Main Memory Unit, Interconnection of units, Communication between units of a computer system; Memory representation and hierarchy, Random Access Memory, Read-only Memory, Classification of secondary storage devices, types of I/O devices; Classification of programming languages, generations of programming languages- Machine Language, Assembly Language, High-level Language, 4GL. | 04 | 10 |
| 2. | **Introduction to C, Constants, Variables and data Types**<br>Features of C language, structure of C Program, Flow Charts and Algorithms Types of errors, debugging, tracing/stepwise execution of program, watching variables values in memory; Character Set, C tokens, Keyword and Identifiers, Constants and Variables, Data types - Declaration and initialization, User define type declarations - typedef, enum, basic input and output operations, symbolic constants, Overflow and underflow of Data. | 06 | 15 |

| | | | |
|---|---|---|---|
| 3. | **Operators, Expressions, and Managing I/O operations**<br>Introduction to Operators and its types, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associatively; Introduction, reading a character, writing a character, formatted input formatted output. | 05 | 10 |
| 4. | **Conditional statements**<br>Decision Making & branching: Decision making with If and If... Else statements, Nesting of If... Else statements, The Switch and go-to statements, The turnery (? :) Operator Looping: The while statement, The break statement & The Do. While loop, The FOR loop, Jump within loops - Programs. | 07 | 15 |
| **Section II** | | | |
| Module No | Content | Hours | Weightage in % |
| 1. | **Arrays**<br>Introduction, One-dimensional arrays, Two-dimensional arrays, Concept of Multidimensional arrays, Dynamic arrays | 05 | 12 |
| 2. | **Strings**<br>Declaring and initializing string variables, Arithmetic operations on Characters, Putting strings together, Comparison of two strings, String Handling Functions | 04 | 10 |
| 3. | **User-Defined Functions**<br>Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function | 04 | 10 |
| 4. | **Structure and Unions**<br>Introduction, Structure definition, declaring and initializing Structure variables, Accessing Structure members, Copying & Comparison of structures, Arrays of structures, Arrays within structures, Structures within Structures, Structures and functions, Unions | 04 | 08 |
| 5. | **Pointers and File management**<br>Basics of pointers, chain of pointers, pointer and array, Pointer to array, array of pointers; Introduction to file management and its functions | 06 | 10 |

**List of Practical/Tutorial:**

| Sr No | Name of Practical/Tutorial | Hours |
|---|---|---|
| 1. | Introduction to Unix Commands | 08 |
| 2. | Basics C Programs | 04 |
| 3. | Implementation in C for Control statements | 16 |
| 4. | Implementation in C for Array and Functions | 16 |
| 5. | Implementation in C for structure and pointer | 10 |
| 6. | Implementation in C for file handling operations | 06 |

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

**Text Books:**

| Title | Author/s | Publication |
|---|---|---|
| Programming in ANSI C | E. Balagurusamy | Tata McGraw Hill |
| Introduction to Computer Science | ITL Education Solutions Limited | Pearson Education |

**Reference Books:**

| Title | Author/s | Publication |
|---|---|---|
| Programming in C | Ashok Kamthane | Pearson |
| Let Us C | Yashavant P. Kanetkar | Tata McGraw Hill |
| Introduction to C Programming | Reema Thareja | Oxford Higher Education |
| Programming with C | Byron Gottfried | Tata McGraw Hill |

**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 Consist of Performance of Practical which should be evaluated out of 10 for each practical and average of the same will be converted to 30 Marks.
- Internal Viva component of 10 Marks.
- Practical performance/quiz/test of 50 Marks during End Semester Exam.
- Viva/Oral performance of 10 Marks during End Semester Exam.

**Course Outcome(s):**

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

- learn the fundamentals of programming.
- develop efficient programs with their own logic & capabilities.
- understand the syntax and semantics of the 'C' language.

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**School of Engineering**

## Department of Computer Engineering

Course Code: SECE1030
Course Name: Programming with Python

**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 | 4 | 0 | 5 | 40 | 60 | 40 | 60 | 0 | 0 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help leaners to
- understand basics of object-oriented programming.
- identify appropriate approach to computational problems.
- develop logic building and problem-solving skills.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Introduction**<br>Basic computer architecture, how a program works, including the concepts of stored instructions, and fetch-decode execute cycle, and multi-tasking, Compare and contrast machine language, assembly language, and high-level languages, Data encoding techniques: binary/decimal conversion and the ASCII table, Hello World program. | 03 | 5 |
| 2. | **Input, Processing and Output**<br>Designing a program, Input and output functions, Python2 v. Python3, Variable types and assignment, Using mathematical operators, Documenting a program. | 06 | 15 |
| 3. | **Decision Structures and Boolean Logic**<br>The Java Environment: Java Program Development, Java Source File Structure, Compilation Executions, Basic Language Elements: Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Data-types, Operators, Introduction to repetition structures, the while loop, The for loop, Calculating a running total, Sentinels, Nested Loops. | 05 | 10 |

| | | | |
|---|---|---|---|
| 4. | **Functions, Lists and Tuples**<br>Introduction to functions, designing custom functions, Local variables, scope of variables, Passing Arguments to functions, and returning values, Local variables, global variables and global constants, Libraries, Sequences, Lists and list slicing, List methods and built-in functions, Copying and processing lists, Two-dimensional Lists, Tuples. | 09 | 20 |
| **Section II** | | | |
| Module No | Content | Hours | Weightage in % |
| 1. | **Array and Strings**<br>Arrays, Basic strings, String slicing, Testing, searching and manipulating strings. | 04 | 10 |
| 2. | **Dictionary and Sets**<br>Dictionaries, Sets, Problem Solving Techniques, Top down design, Bottom Up implementation | 05 | 15 |
| 3. | **Object -Oriented Programming Concepts**<br>Procedural and Object -Oriented programming, Classes Working with instances, Designing classes. | 06 | 15 |
| 4. | **Files**<br>Introduction to file input and output, Using loops to process files, Processing records, Exceptions. | 02 | 10 |

**List of Practical/Tutorials:**

| Sr No | Name of Practical/Tutorial | Hours |
|---|---|---|
| 1. | Introduction to Python Environment and Idles. | 02 |
| 2. | Class and Functions in Python. | 08 |
| 3. | Dictionaries, Sets, Tuples and Lists in python. | 04 |
| 4. | Arrays and Strings in Python | 04 |
| 5. | File Handling in Python. | 06 |

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

**Text Book:**

| Title | Author/s | Publication |
|---|---|---|
| Learning to Program with Python | Richard L. Halter man | Pearson |

**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 Consist of Performance of Practical which should be evaluated out of 10 for each practical and average of the same will be converted to 30 Marks.
- Internal Viva component of 10 Marks.
- Practical performance/quiz/test of 50 Marks during End Semester Exam.
- Viva/Oral performance of 10 Marks during End Semester Exam.

**Course Outcome(s):**

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

- learn the fundamentals of object-oriented programming.
- develop efficient programs with their own logic & capabilities.
- understand the syntax and semantics of the 'Python' language.

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## Department of Information Technology

Course Code: SEIT1010
Course Name: Introduction to Web Designing

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 0 | 4 | 0 | 2 | 0 | 0 | 50 | 50 | 0 | 0 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand basic components of internet.
- learn basic web technologies such as HTML, JavaScript and CSS.
- develop basic knowledge of website designing.

**Course Content:**

| Module | Content | Hours | Weightage |
|---|---|---|---|
| 1. | Introduction to World Wide Web, Web Server, Website, Website design principles, planning the website, navigation, Introduction to HTML, CSS, Bootstrap CSS | 60 | 100% |

**List of Practical/Tutorial:**

| **Sr No** | **Name of Practical/Tutorial** | **Hours** |
|---|---|---|
| 1. | Implementation of HTML tags | 20 |
| 2. | Designing Websites with basic CSS | 5 |
| 3. | Designing of Responsive Website Designs using Bootstrap CSS | 5 |
| 4. | Development of mini project based on HTML, CSS and Bootstrap CSS | 30 |

**Reference Book:**

| **Title** | **Author/s** | **Publication** |
|---|---|---|
| HTML Black Book | Steven Holzner | Dreamtech press |

**Web Material Links:**
https://www.w3schools.com/

**Course Evaluation:**

**Practical:**

- Continuous Evaluation Consist of Performance of Practical which should be evaluated out of 10 for each practical and average of the same will be converted to 50 Marks.
- Prepared Project during practical hours will be evaluated as a part of end semester evaluation which carries 50 Marks weightages.

**Course Outcome(s):**

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

- learn the fundamentals of Website designing.
- apply knowledge of HTML, CSS, and JavaScript to build static and dynamic websites.

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

## Department of Science & Humanities

Course Code: SESH1010
Course Name: Elementary Mathematics for Engineers
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 | - | - | 50 | 0 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- summarize concepts of calculus to enhance ability of analyzing mathematical problems.
- acquire knowledge and ability to work with differentiation and integration for applications of mathematical techniques in engineering.
- make use of multiple integration for finding area, volume and mass of solid objects.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Introduction to Limit, Continuity & Differentiation**<br>Limits, Continuity, Discontinuity, Types of discontinuity, Successive Differentiation, Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem | 6 | 15 |
| 2. | **Sequence and Infinite Series**<br>Convergence, Divergence of sequence, Divergence of infinite series, Tests for convergence of series (Comparison, Integral, Ratio and Root), Alternating series, Absolute and Conditional convergence, Power series with applications, Taylor's and Maclaurin's series, Indeterminate forms($0/0$, $\infty/\infty$, $\infty.0$, $\infty - \infty$, $0^{\infty}$, $\infty^{0}$ & $1^{\infty}$). | 10 | 20 |
| 3. | **Curve tracing**<br>Tracing of Cartesian Curves, Polar coordinates, Polar and Parametric form of standard curves, Areas and Lengths in polar coordinates | 7 | 15 |

| Section II | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Partial Derivatives**<br>Function of several variables, Partial differentiation, Applications, Chain rule, Tangent planes and Linear approximations, Maxima and Minima, Euler's theorem, Lagrange multiplier, Total differentiation. | 8 | 18 |
| 2. | **Beta Gama function**<br>Improper Integrals, Beta and Gamma function with their properties and duplications formula without proof. | 4 | 12 |
| 3. | **Multiple Integrals**<br>Double integral (in Cartesian and Polar coordinates), Triple integral (in Cartesian, Cylindrical and Spherical coordinates), Change order of integration, Change of variables, Applications of double and triple integrals for evaluation of Area, Volume and Mass. | 10 | 20 |

**List of Tutorial:**

| Sr No | Name of Tutorial | Hours |
|---|---|---|
| 1. | Limit, Continuity & Differentiation | 4 |
| 2. | Sequence and Infinite Series -1 | 3 |
| 3. | Sequence and Infinite Series-2 | 3 |
| 4. | Curve Tracing-1 | 3 |
| 5. | Curve Tracing-2 | 2 |
| 6. | Partial Derivatives-1 | 3 |
| 7. | Partial Derivatives-2 | 3 |
| 8. | Beta Gama Function | 2 |
| 9. | Multiple Integrals-1 | 4 |
| 10. | Multiple Integrals-2 | 3 |

**Text Book:**

| Title | Author/s | Publication |
|---|---|---|
| Thomas' Calculus | George B. Thomas, Maurice D. Weir, Joel Hass | Pearson |

**Reference Books:**

| Title | Author/s | Publication |
|---|---|---|
| Advanced Engineering Mathematics | Erwin Kreyszig | Wiley India Edition |
| Calculus with Early Transcendental Functions | James Stewart | Cengage Learning |
| Calculus | Robert T. Smith, Roland B. Minton | Tata McGraw Hill |
| Engineering Mathematics-1(Calculus) | H. K. Dass, Dr. Rama Verma | S. Chand |

**Web Material Links:**

- http://nptel.ac.in/courses/111104085/
- http://nptel.ac.in/courses/111104095/
- http://nptel.ac.in/courses/111105069/

**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.
- MCQ based examination of 10 Marks.
- Internal Viva component of 10 Marks.

**Course Outcome(s):**

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

- make use of concepts of limit, continuity and differentiability for analyzing mathematical problems.
- examine series for its convergence and divergence.
- formulate differential and integral operations.
- evaluate functions like Gamma, Beta functions & their relation which is helpful to evaluate some definite integral arising in various branch of engineering.
- applications of Limit, Derivatives and Integrals.

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

## Department of Science & Humanities

Course Code: SESH1020
Course Name: Linear Algebra & Vector 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 | |
| 3 | 0 | 2 | 5 | 40 | 60 | - | - | 50 | 0 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- analyze 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 and vector calculus for solving science and engineering problems.

**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 (Homogeneous and Non-homogeneous), Characteristic equation, Eigenvalues, Eigenvector, Diagonalization, Caley-Hamilton theorem,. | 9 | 20 |
| 2. | **Vector Space**<br>Vector spaces, Subspaces, Linear Combination, Linear Dependence, Linear Independence, Span, Basis and Dimension, Row space, Column space and Null space, Rank and Nullity | 8 | 18 |
| 3. | **Linear Transformation**<br>Introduction Linear Transformation, Kernel and Range, Inverse Linear Transformation, Matrix representation of Linear Transformation | 6 | 12 |

| Section II | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Inner Product Space**<br>Inner products, Angle and Orthogonality, Orthogonal projection, Orthonormal bases (Gram-Schmidt Process, QR-Decomposition), Least Square Approximation, Change of basis. | 8 | 18 |
| 2. | **Vector Calculus and its Applications**<br>Vector & Scalar functions and Fields, Curve, Arc length, Curvature & Torsion gradient of scalar field, Directional derivative divergence of a vector field, Curl of a vector field | 7 | 16 |
| 3. | **Integral Calculus**<br>Line integrals, Path Independence of line integrals, Green`s theorem in the plane, Surface integrals, Divergence theorem of Gauss, Stokes`s theorem | 7 | 16 |

**List of Tutorial:**

| Sr No | Name of Tutorial | Hours |
|---|---|---|
| 1. | Matrix Algebra-1 | 4 |
| 2. | Matrix Algebra-2 | 4 |
| 3. | Vector Space-1 | 3 |
| 4. | Vector Space-2 | 2 |
| 5. | Vector Space-3 | 2 |
| 6. | Inner Product Space-1 | 4 |
| 7. | Vector Calculus-1 | 2 |
| 8. | Vector Calculus-2 | 3 |
| 9. | Integral Calculus-1 | 3 |
| 10. | Integral Calculus-2 | 3 |

**Text Books:**

| Title | Author/s | Publication |
|---|---|---|
| Elementary Linear Algebra Applications Version | Howard Anton, Charis Rorres | Wiley India Edition |
| Thomas' Calculus | George B. Thomas, Maurice D. Weir, Joel Hass | Pearson |

**Reference Books:**

| Title | Author/s | Publication |
|---|---|---|
| Advanced Engineering Mathematics | Erwin Kreyszig | Wiley India Edition |
| Higher Engineering Mathematics | B. V. Ramana | Tata McGraw Hill |
| Linear Algebra and its Applications | David C. Lay | Pearson |
| Introduction to Linear Algebra with Application | Jim Defranza, Daniel Gagliardi | Tata McGraw Hill |
| Elementary Linear Algebra | Ron Larson | Cengage Learning |

**Web Material Links:**

- http://nptel.ac.in/courses/111106051/
- http://nptel.ac.in/courses/111108066/
- http://nptel.ac.in/downloads/111102011/
- http://epgp.inflibnet.ac.in/view_f.php?category=1564

**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.
- MCQ based examination of 10 Marks.
- Internal Viva component of 10 Marks.

**Course Outcome(s):**

By the end of the course, the student will be able to

- solve linear system using matrices.
- understand the concepts of Vector Space, Linear Transformation and inner product space.
- summarize vector functions, their derivatives, integrals, arc length and curl of vector field.
- apply the fundamental concepts of calculus to understand integrals calculus.

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

**Department of Applied sciences & Humanities**

Course Code: SESH1030
Course Name: Electronics Workshop

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 0 | 2 | 0 | 1 | 0 | 0 | 40 | 60 | 0 | 0 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand basic fundamental electronic circuit.
- learn to use common electronic component.
- understand components of instruments, terminology and applications.

**List of Practical:**

| Sr No | Name of Practical | Hours |
|---|---|---|
| 1 | Understanding of electronic component with specification. | 4 |
| 2 | Basic Circuit Diagram. | 2 |
| 3 | Study of CRO & Measurement of Voltage Amplitude & Frequency | 2 |
| 4 | To construct logic gates AND, NOT, EX-NOR and EX-OR using NANAD gates and verify their truth tables. | 4 |
| 5 | Introduction to Electronic Virtual Laboratory | 4 |
| 6 | Analog to digital converter. | 3 |
| 7 | Digital to analog convertor | 3 |
| 8 | Operational amplifier lab | 4 |
| 9 | Bread board understanding. | 2 |
| 10 | Introduction to CRO. | 2 |

**Text Book:**

| Title | Author/s | Publication |
|---|---|---|
| Electronic Principles | Albert Malvino and David J Bates | Mc Graw Hill(7th Edition) |

**Reference Book:**

| Title | Author/s | Publication |
|---|---|---|
| Electronic Devices | Thomas L. Floyd | Pearson (7th Edition) |
| Electronic Devices and Circuits | David A. Bell | Oxford Press (5th Edition) |
| Integrated Electronics | Jacob Millman, Christos | Tata McGraw Hill (2nd Edition) |

**Course Evaluation:**

**Practical:**

- Continuous Evaluation Consist 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/test of 15 Marks during End Semester Exam.
- Viva/Oral performance of 15 Marks during End Semester Exam.

**Course Outcome(s):**

- Students will be able to design elementary combinational and sequential circuits.

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

## Department of Science & Humanities

Course Code: SESH1210
Course Name: Applied Physics
Prerequisite Course(s): Concept of Physics and Mathematics up to 12th Science

**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 | 2 | 0 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |

CE: Continuous Evolution, ESE: End Semester Exam

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

- prepare students for careers in engineering where physics principles can be applied to the advancement of technology.
- think in core concept of engineering application by studying various topics involved in branch specific application.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Quantum Mechanics**<br>Wave-Particle duality, de-Broglie matter wave, phase and group velocity, Heisenberg uncertainty principle and its applications, wave function and its significance, Schrodinger's wave equation, particle in one dimensional box. | 08 | 20 |
| 2 | **Acousic And Ultrasonic**<br>Introduction, classification and characterization of sound, Absorption Coefficients, Sound Absorbing materials, Sound Insulation, Ultrasonic, Properties of Ultrasonic, Generation of Ultrasonic applications of ultrasonic. | 06 | 15 |
| 3 | **Solid State Physics**<br>Introduction, Lattice Points and space lattice, unit cells and lattice parameters, Primitive cell, Crystal systems. The Bravais space lattices. Miller indices, X-Ray properties, Diffraction and Bragg's law, Bragg's X-Ray spectrum | 07 | 15 |

| Section II | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Non-Linear Optics**<br>LASER, Spontaneous and Stimulated emission of light, applications of LASER; Fundamental ideas about Optical fibre, Advantages of Optical fibre of optical fibre, Applications of optical fibre. | 06 | 12 |
| 2. | **DC and AC Circuits Fundamentals**<br>Introduction of Electrical Current, Voltage, Power and Energy; Sources of Electrical Energy Inductor and Capacitor, Fundamental laws of electric circuits – Ohm's Law and Kirchhoff's Laws; Analysis of series, parallel and series-parallel circuits.<br>Alternating voltages and currents and their vector and time domain representations, average and RMS values, from factor, phase difference, power and power factor, purely resistive inductive and capacitive circuits, R-L, R-C, R-L-C series circuits, impedance and admittance, circuits in parallel, series and parallel resonance. | 12 | 25 |
| 3. | **Electronics**<br>Semiconductors, Intrinsic and Extrinsic Semiconductor Advantages of Semiconductor Devices, Diodes, Transistors, Types of Bipolar Junction Transistor, Unijunction Transistor, FET and MOSFETS. | 06 | 13 |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1 | Volt-Ampere Characteristics of Light Emitting Diode | 02 |
| 2 | Volt-Ampere Characteristics of Zener Diode | 02 |
| 3 | To determine value of Planck's constant (h) using a photovoltaic cell | 02 |
| 4 | To determine the Hall coefficient (R) and carrier concentration of a given material (Ge) using Hall effect | 04 |
| 5 | To study the Capacitors in series and parallel DC circuit | 04 |
| 6 | To study hysteresis loop for a magnetic material on CRO | 02 |
| 7 | To determine velocity of sound in liquid using Ultrasonic Interferometer | 04 |
| 8 | To study RLC Series circuit | 02 |
| 9 | To determine numerical aperture of an optical fiber | 02 |
| 10 | Determination of Young's Modulus of given material | 02 |
| 11 | Analysis of errors | 02 |

**Text Books:**

| Title | Author / s | Publication |
|---|---|---|
| Concept of the Modern Physics | A. Beiser | Tata McGraw-Hill Education |
| Quantum Mechanics | P.M. Mathew,K. Venkatesan | Tata McGraw-Hill Education |
| Waves and Acoustics | Pradipkumar Chakrabarti Satyabrata Chawdhary | New Central Book Agency |
| Lasers and Nonlinear Optics | G.D. Baruah | Pragati Prakashan |
| Solid State Physics | S.O. Pillai | New Age International Publishers |
| Basic Electronics for Scientists and Engineers | Dennis L. Eggleston | Cambridge University Press |

**Web material Link:**
http://nptel.ac.in/course.php

**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 Consist 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 component of 10 Marks.
- Practical performance/quiz/drawing/test of 20 Marks during End Semester Exam.
- Viva/Oral performance of 10 Marks during End Semester Exam.

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

- use appropriate mathematical techniques and concepts to obtain quantitative solutions to problems in physics & electrical.
- perform a literature search, to make use of appropriate computational of laboratory skill, and to make an effective written or oral presentation of the results of the project.

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

## Department of Science & Humanities

Course Code: SESH1220
Course Name: 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 | |
| 3 | 2 | 0 | 4 | 40 | 60 | 25 | 25 | - | - | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- present sound knowledge of chemistry fundamentals, enriching students to understand the role of Chemistry in the field of science and engineering.
- inculcate habit of scientific reasoning to do the task rationally.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No | Content | Hours | Weightage in % |
| 1. | **Chemical Bonding and Structure of Molecules**<br>**General terms**: Chemical bond, valence, valence electrons, Bonding and Non bonding electrons, Lewis symbols, Octet rule.<br>**Ionic bond**: Definition, Condition for formation of ionic bond, Factors governing formation of ionic bond, examples (NaCl, $MgCl_2$, CaO, $Al_2O_3$), Characteristics of ionic compounds.<br>**Covalent bond:** Definition, conditions for covalent bond formation, examples [(single covalent bond: $H_2$, $Cl_2$, $H_2O$, $NH_3$, $CH_4$) (multiple covalent bond: $O_2$, $N_2$, $CO_2$)], General characteristics of covalent compounds, valence bond approach, formation of $H_2$ molecule, Concept of hybridization, Hybridization and shape of molecules, Shape of water, ammonia, PCL5 and SF6, Limitations of Valence bond theory, VSEPR theory, Fajan's rules.<br>**Co-ordinate covalent bond:** Definitions, examples ($NH_4^+$, $H_3O^+$, $BF_4^-$, $CH_3NO_2$, $SO_3$, $AlCl_3$, $SO_4^{-2}$, $O_3$ and CO.<br>**Hydrogen bonding:** Definition, conditions for H-bond formation, examples (HF, $H_2O$, $NH_3$, 2-nitrophenol), Types of H-bonds, Characteristics of H-bonded compounds. | 09 | 20 |

| | | | |
|---|---|---|---|
| | **Metallic bond:** Definition, The Electron sea model, explanation to the physical characteristics of metal based on the electron sea model. | | |
| 2. | **Electrochemistry**<br>Introduction, Arrhenius ionic theory, De-bye Huckel theory of strong electrolytes, activity and activity co-efficient, Conductivity of electrolytes, Kohlrausch's law of independent migration of ions, Ostwald's dilution law, Acids and bases, Concept of pH and pOH, Buffer solutions, Solubility product, common-ion effect, hydrolysis of salts, conductometric titration, transport number. | 04 | 09 |
| 3. | **Reaction Intermediates in organic reaction**<br>(Definition and example only)<br>Homolytic and Heterolytic bond fission, Nucleophiles and electrophiles, Leaving group; Stability, Generation, Reaction and applications of reaction intermediates (Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes, Benzynes) | 09 | 20 |
| **Section II** | | | |
| Module No | Content | Hours | Weightage in % |
| 1. | **Bio Chemistry**<br>Introduction to metabolism in a cell. Overview of metabolic pathways. Regulation of Pathways at : (a) BioChemical Level and (b) Genetic Level. Chemicals from metabolic Pathways using microorganism. | 07 | 15 |
| 2. | **Phyto Chemistry**<br>Chemicals from Plants. Secondary Metabolites and their medicinal values. Future prospects of phytochemistry in chemical manufacturing and in the treatment of diseases; Role of Chemical Engineers in the Phytochemical industry | 04 | 10 |
| 3. | **Water Treatment**<br>Introduction, Characteristics imparted by impurities in water, Hardness of water, equivalents of calcium carbonate, units of hardness, disadvantages of hard water, scale and sludge formation in boilers, caustic Embrittlement, boiler corrosion, Priming and Foaming, softening methods, Drinking or Municipal water, Desalination of Brackish water. | 07 | 15 |
| 4. | **Colloids**<br>Lyophilic and Lyophobic colloids, Characteristics of lyophilic and lyophobic sols, preparation of sols, Dispersion methods, Aggregation methods, Purification of sols, Dialysis, optical properties of sols: Tyndall effect, kinetic properties of sols, Brownian movement, Electrical properties of sols: Electrophersis, Stability of sols, associated colloids, cleansing action of soaps and detergents, emulsions, gels, applications of | 05 | 10 |

| | | | |
|---|---|---|---|
| | colloids, determination of molecular weight of macromolecules. | | |

**List of Practical/Tutorial:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Quantitative analysis etc. | 2 |
| 2. | Demonstration: Preparation of solutions of different concentrations | 2 |
| 3. | Determination of alkalinity in the given water sample. | 2 |
| 4. | Determination of temporary and permanent hardness in water sample using EDTA as standard solution. | 2 |
| 5. | Conduct metric titration of strong acid vs. strong base. | 2 |
| 6. | Determination of critical micelle concentration of a surfactant using conductometry. | 2 |
| 7. | Determination of concentration of unknown solution spectrophotometrically. | 2 |
| 8. | Determining the strength of ferrous ammonium sulfate with the help of $K_2Cr_2O_7$. | 2 |
| 9. | Determination of dissociation constant of strong acid by pH metric method. | 2 |
| 10. | To determine the critical micelle concentration of a surfactant using surface tension method. | 2 |
| 11. | Determination of molecular weight of a polymer by using viscometer. | 2 |
| 12. | To determine λ max of the solution of (a) $KMnO_4$ (b) $K_2Cr_2O_7$. | 2 |
| 13. | Determination of cloud point of a surfactant in the presence of salts. | 2 |
| 14. | To determine the viscosity of given solvents using viscometer. | 2 |
| 15. | Revision | 2 |

**Text Book:**

| Title | Author/s | Publication |
|---|---|---|
| Engineering Chemistry (16th Edition) | P.C. Jain and Monika Jain | Dhanpat Rai publishing company |

**Reference Books:**

| Title | Author/s | Publication |
|---|---|---|
| Textbook of Engineering Chemistry (4th Edition) | R. Gopalan, D. Venkappaya, S. Nagarajan | Vikas Publishing house Ltd. |
| A textbook of Chemical technology (Volume-1) | G. N. Pandey | Vikas Publishing house Ltd. |
| Essentials of Physical Chemistry | A.Bahl, B.S. Bahl and G.d. Tuli | S. Chand Publishing |
| Concise Inorganic Chemistry | J.D. Lee | Wiley India |
| Organic Reaction Mechanisms | V. K. Ahluwalia, R. K. Parashar | Norasa Publishing House |
| Organic Chemistry (6th edition) | Robert Thornnton Morrison<br>Robert Neilson Boyd | Pearson Education |

**Web Material Link:**
https://books.google.co.in/books?id=Z3033BGuMBEC&printsec=frontcover&dq=engineering+chemistry+ebook&hl=en&sa=X&ved=0ahUKEwj9xoiNv3UAhVEL48KHYg7Ak0Q6AEIITAA#v=onepage&q&f=false

**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 consist of performance of practical which should be evaluated out of 10 for each practical and average of the same will be converted to 15 Marks.
- Internal Viva component of 10 Marks.
- Practical performance of 15 Marks during End Semester Exam.
- Viva performance of 10 Marks during End Semester Exam.

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

- understand the relevance of fundamental and applications of chemical sciences and chemistry in the field of engineering.
- apply the knowledge of types of hardness of water and its estimation.
- apply the knowledge of thermodynamics in studying different chemical systems.
- apply the knowledge of Colloids, metals and alloys, their types and their properties.
- have sound knowledge on Electrochemistry.

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

## Centre for Skill Enhancement & Professional Development

Course Code: SEPD1010
Course Name: Academic English and Technical Writing
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 | 00 | 03 | 40 | 60 | 20 | 30 | -- | -- | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to
- improve speaking, listening, reading and writing skills in an academic environment.
- write academic texts effectively, as well as improve grammar and vocabulary.
- express ideas clearly and accurately with accurate writing.
- form and practice strategies for reading in the academic contexts quickly and effectively.
- gain confidence in speaking English in an academic context and also analyze and improve pronunciation.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Academic English**<br>• General English Vs Academic English<br>• Academic Vocabulary<br>• Grammar for Academic Purposes | 03 | 10 |
| 2. | **Academic Reading**<br>• Introduction to Reading<br>• Types of Reading<br>• Techniques of Reading | 06 | 20 |
| 3. | **Academic Listening**<br>• Introduction to Listening<br>• Types of Listening<br>• Techniques of Listening | 06 | 20 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Academic Speaking**<br>• Introduction to Speech and Its importance | 07 | 25 |

| | | | |
|---|---|---|---|
| | • Phonetics and Transcription to effective pronunciation<br>• Speaking in various contexts | | |
| 2. | **Technical Writing**<br>• Understanding clauses and Syntax<br>• Cohesion and Coherence/ Building Paragraphs<br>• Flow/ structure of Writing<br>• Punctuations<br>• Application/ Letter Writing<br>• Review/ Report Writing<br>• E-mail etiquettes | 08 | 25 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction to Academic English – Ice Breaker | 02 |
| 2. | Introduction to Academic English – Vocabulary Games and Grammar Activity | 02 |
| 3. | Reading for Summarizing and Paraphrasing | 02 |
| 4. | Reading for review writing/ Skimming and Scanning Web Resources | 02 |
| 5. | Comprehensive Listening: Note Taking and Note Making | 02 |
| 6. | Comprehensive Listening: Summarizing and Paraphrasing | 02 |
| 7. | Critical Listening: An analysis | 02 |
| 8. | Speech for Pronunciation | 02 |
| 9. | Speech for Presentation | 02 |
| 10. | Speech for Fluency | 02 |
| 11. | Conversational Skills | 02 |
| 12. | Academic Writing: Paragraph Building | 02 |
| 13. | Academic Writing: Critical Review Writing | 02 |
| 14. | Leave Application/ Request Letter/Business Letter | 02 |
| 15. | Notice/Memo/Agenda/ Minutes | 02 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Practical Techniques to Develop Communication Skills | Parul Popat & Kaushal Kotadia | Pothi Prakashan, 2015 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| English for Academic Purposes: A Guide and Resource Book for Teachers | R. R. Jordan | Cambridge University Press, 1997 |
| English for Academic Purposes: An Advanced Resource Book | Ken Hyland | Routledge, 2006 |
| Engineers' Guide to Technical Writing | Kenneth G. Budinski | ASM International, 2001 |

| | | |
|---|---|---|
| Communication Skills | Parul Popat & Kaushal Kotadia | Pearson, 2015 |

**Web Material Link(s):**

- https://msu.edu/course/be/485/bewritingguideV2.0.pdf
- https://www.khanacademy.org
- http://www.kantakji.com/media/6494/t121.pdf

**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 consists of 60 marks.

**Practical/Tutorial:**

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

- effectively use LSRW skills in English in an academic environment.
- write Academic English effectively with improved grammar and vocabulary.
- practice strategies for comprehensive reading in English.
- speak English in an academic context fluently and efficiently.

# P P Savani University
# School of Engineering

## Centre for Skill Enhancement & Professional Development

Course Code: SEPD1020
Course Name: Communication Skills
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 | 00 | 03 | 40 | 60 | 20 | 30 | -- | -- | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- hone basic communication skills by exposing them to the key communication techniques, and thereby.
- improvise comprehension and expressional skills which are required for personal, social, academic and professional environment.
- sharpen Communication Skills with reference to Organizational Structure.
- expose to the modern modes of communication.
- show the importance of team work and give practice in Group Communication with reference to Group Dynamics.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Communication Skills**<br>• Concept and Process of Communication<br>• Types of Communication<br>• Principles of Effective Communication<br>• Barriers to Communication | 06 | 20 |
| 2. | **Interpersonal Organizational Communication**<br>• Styles of Communication<br>• Flows of Communication<br>• Essentials of Organizational Communication<br>• Kinesics, Proxemics and Chronemics<br>• Cross cultural Communication | 06 | 20 |
| 3. | **Team/ Group Dynamics and Leadership**<br>• Introduction to Group Work and Group Dynamics | 03 | 10 |

| | | | |
|---|---|---|---|
| | • Types of Groups and Essentials of Group Work and networking<br>• Concept and Types of Leadership<br>• Traits of an Effective Leader | | |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Presentation Skills**<br>• Introduction to presentation and its importance<br>• Modes, means and purposes of presentation<br>• Defining purpose, analyzing audience and organizing the contents<br>• Visual aids and nuances of delivery<br>• Body language and effective presentation | 08 | 25 |
| 2. | **Communication and Contemporary World**<br>• Introduction to Contemporary personal, social and professional set ups<br>• Modern Day Communication tools and their efficacy<br>• Effective usage of Modern-Day Communication tools for personal and professional growth | 07 | 25 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Introduction to Communication: An Ice Breaker | 02 |
| 2. | Verbal/ Non-Verbal Communication Pros and Cons | 02 |
| 3. | Principles of Communication | 02 |
| 4. | Interpersonal Communication | 02 |
| 5. | Organizational Communication | 02 |
| 6. | Assertive Vs Aggressive Communication | 02 |
| 7. | Group Dynamics: A Decision-Making Activity | 02 |
| 8. | Group Dynamics Working together to achieve organizational vision | 02 |
| 9. | Leadership: Holding a diverse Group Together | 02 |
| 10. | Presentation Skills; Video Session | 02 |
| 11. | Presentations by the Students: Self-Peer-teacher assessment | 02 |
| 12. | Presentations by the Students: Self-Peer-teacher assessment | 02 |
| 13. | Discussion on Modern Day Communication | 02 |
| 14. | Modern Day Communication and Contemporary Society | 02 |
| 15. | Exploring Innovative Communication Tools for effective communication | 02 |

**Text Book (s):**

| Title | Author/s | Publication |
|---|---|---|
| Practical Techniques to Develop Communication Skills | Parul Popat & Kaushal Kotadia | Pothi Prakashan, 2015 |

**Reference Book (s):**

| Title | Author/s | Publication |
|---|---|---|
| Communication Skills | Parul Popat & Kaushal Kotadia | Pearson, 2015 |
| Communication Skills, Second Edition | Sanjay Kumar, PushpLata | Oxford University Press, 2015 |
| Communication Skills for Engineers | Sunita Mishra | Pearson, 2011 |
| Effective Interpersonal and Team Communication Skills for Engineers | Clifford Whitcomb, Leslie E. Whitcomb | John Wiley & Sons, 2012 |

**Web Material Link (s):**

- http://www.mindtools.com/page8.html
- http://techpreparation.com/soft-skills.htm?gclid=CJf34fyQv5wCFdMtpAodjjX_tA
- http://lorien.ncl.ac.uk/ming/Dept/Tips/present/comms.htm

**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 consists of 60 marks.

**Practical/Tutorial:**

- Continuous Evaluation consists of Performance of Practical which should be evaluated out of 10 for each practical in the next turn 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 completion of the course, the student will be able to

- follow the process of communication and its components in organizational context.
- express themselves and to participate in the classroom discussions and other such academic or academic support activities.
- comprehend whatever they receive from Informal Interactions with the family, teachers and friends; and from Formal Communications taking Place in Lectures, Laboratories and the like.
- communicate effectively using suitable styles and techniques.
- express themselves through the modern modes of communication and to participate in the group discussions and other such academic or academic support activities.
- use language effectively with reference to communication in groups and group behavior.
- understand and use latest and innovative communication tools to enhance their communication efficacy.

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

## Department of Information Technology

Course Code: SEIT1020
Course Name: Logic Building & Problem Solving

**Teaching & Examination Scheme:**

| Teaching Scheme (Hours/Week) | | | | Examination Scheme (Marks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | CE | ESE | CE | ESE | CE | ESE | |
| 1 | 0 | 1 | 2 | 50 | 50 | 0 | 0 | 50 | 50 | 200 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- To understand basic components of logic building.
- To learn and analyze various logical reasoning techniques.
- To develop basic problem-solving skills.

**Course Content:**

| Module No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1 | Orientation Formal Deductive Logic, Categorical Propositions Informal Logic, Basic Concepts, meaning and definition, Categorical Syllogisms, Informal fallacies Inductive Logic, Analogy and Legal and moral Reasoning, Propositional Logic Unit, Causality and Mill's Methods, Probability Unit, Natural Deduction in propositional logic, Statistical reasoning, Hypothetical/Scientific reasoning, Science and superstition, Predicate logic. | 30 | 100 |

**Web Material Links:**
https://www.coursera.org/learn/logic-introduction#syllabus

**Course Evaluation:**
**Practical:**

- Continuous Evaluation consists of performance of tutorial, which should be evaluated out of 10 per each tutorial. At the end of the semester, average of the entire tutorial will be converted to 50 Marks.
- Prepared Problem based Case Study/Assignments during Lecture/Tutorial hours will be evaluated as a part of end semester evaluation which carries 50 Marks weightages.

**Course Outcome(s):**

- Students will learn the fundamentals of logical reasoning.
- Students can apply knowledge of logical reasoning in solving basic real-world issues.

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

## Department of Science & Humanities

Course Code: SESH1050
Course Name: Solution to Societal Problems: A Community Service Approach
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 | |
| 0 | 2 | 0 | 1 | 0 | 0 | 50 | 0 | 0 | 0 | 50 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- Identify the societal problems at ground level
- Understand the concerns and seriousness of the reality at first hand experiences
- Try to find out the solutions and apply them as much as possible
- Comprehend the concept of Community Service while being a professional

**Outline of the Project:**

| Sr. No. | Project Guidelines |
|---|---|
| 1 | Identification of Societal Problem |
| 2 | Data Collection |
| 3 | Literature Review |
| 4 | Progress of Project |
| 5 | Report Writing |
| 6 | Presentation & Question-Answer |

**Detailed Guidelines:**

| Module No | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | **Identification of Societal Problem**<br>Outline of identified issue of society shall be prepared by the student/ group of students (Maximum 3). | 3 | 10 |
| 2. | **Data Collection**<br>Collection of data for the respective societal issue, societal impact and remedies shall be covered. | 3 | 10 |
| 3. | **Literature Review**<br>Mapping of the efforts carried out by the other candidates/authorities/organizations. | 3 | 10 |

| | | | |
|---|---|---|---|
| 4. | **Progress of Project**<br>The students must report the progress/status of their work every fortnight to their respective supervisor. | 12 | 40 |
| 5. | **Report Writing**<br>The report must be prepared as per suggested guidelines consisting of Preamble, Objectives, Scope, Survey Methodology, Data Collection, Data Analysis, Design (if any), Conclusions, Recommendations and Annexure. | 6 | 10 % |
| 6. | **Presentation & Question-Answer**<br>At the end of the semester the student/group of students shall give presentation of their work followed by viva-voce examination. | 3 | 10 % |

**Instructional Method and Pedagogy:**

- The student/group of students (Maximum 3) will identify any societal issue based on their inclination/willingness/interest/experience.
- The project will include visits as per demand of the project, where student/group of students can avail an opportunity to develop understanding based on their first-hand experience of actual scenario of society and its problems.
- Work progress of the project will be assessed and evaluated regularly by the mentor as per the evaluation guidelines.
- The mentor will visit the site of the project carried out by students under him, if need be.
- At the end of the semester, students have to submit the final project report followed by the presentation and Question-Answer. The submission of the project shall be done as per the guidance of the supervisor.
- At the end of the semester, the projects (certified by the supervisor/principal only) will be evaluated as per suggested evaluation criteria.

**Course Evaluation:**

| Sr. No. | Evaluation criteria | Marks |
|---|---|---|
| 1 | Identification of the problem related field work (Within first 30 Days of commencement of semester) | 20 |
| 2 | Presentation of problem & proposed solution (Within 31 to 40 Days of commencement of semester) | 20 |
| 3 | Actual work carried out & impact of solution (Within 41 to 60 Days of commencement of semester) | 20 |
| 4 | Report writing as per guidelines | 20 |
| 5 | Final Presentation & Question-Answer session | 20 |
| | **Grand Total:** | **100** |

**The entire evaluation will be converted equivalent to 50 Marks.**

**Course Outcome(s):**

By the end of the course, the student will be able to:

- Learn to analyze the societal problems by the methods of survey, observation, statistics, interview and so on.
- Examine the identified issued in order to find best possible solutions

- Formulate and apply the methods to apply the solution
- Study the applications of their respective field for Community Service.

**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

# SECOND YEAR B. TECH.

**P P SAVANI UNIVERSITY**

**SCHOOL OF ENGINEERING**

**TEACHING & EXAMINATION SCHEME FOR B.TECH. SECOND YEAR CHEMICAL ENGINEERING PROGRAMME**

| Sem | Course Code | Course Name | Teaching Scheme | | | | | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Contact Hours | | | | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | Theory | Practical | Tutorial | Total | | CE | ESE | CE | ESE | CE | ESE | |
| 3 | SESH2031 | Differential Methods for Chemical Engineers | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |
| | SECH2010 | Chemical Process Calculation | 3 | 0 | 1 | 4 | 4 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |
| | SECH2020 | Mechanical Operations | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |
| | SECH2030 | Unit Processes in Organic Synthesis | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |
| | SECH2040 | Chemical Engineering Materials and Metallurgy | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |
| | SEPD2010 | Critical Thinking, Creativity & Decision Making | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |
| | SEPD3040 | Integrated Personality Development Course-I | 2 | 0 | 0 | 2 | 1 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH2910 | Industrial Exposure | 2 | | | 0 | 2 | 00 | 00 | 100 | 00 | 00 | 00 | 100 |
| | | **Total** | | | | **28** | **26** | | | | | | | **1050** |
| 4 | SESH2022 | Numerical & Statistical Analysis | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |
| | SECH2050 | Fluid Flow Operations | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |
| | SECH2061 | Physical, Inorganic & Analytical Chemistry | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |
| | SECH2070 | Chemical Engineering Thermodynamics-I | 3 | 0 | 2 | 5 | 5 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |
| | SECH2080 | Mass Transfer Operations – I | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |
| | SEPD3050 | Integrated Personality Development Course-II | 2 | 0 | 0 | 2 | 1 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SEPD3030 | Foreign Language (German) | 3 | 0 | 2 | 2 | 2 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |
| | | **Total** | | | | **29** | **25** | | | | | | | **950** |

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

**Department of Science & Humanities**

Course Code: SESH2031
Course Name: Differential Methods for Chemical Engineers
Prerequisite Course(s): SESH1010-Elementary Mathematics for Engineers

**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 | 02 | 05 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |

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 Integral Transforms for solving linear differential equations.
- learn introduction of Periodic functions and Fourier series with their applications for solving ODEs.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Ordinary Differential Equation**<br>First order ODEs, Formation of differential equations, Solution of differential equation, Solution of equations in separable form, Exact first order ODEs, Linear first order ODEs, Bernoulli Equation, ODEs of Second and Higher order, Homogeneous linear ODEs, Linear Dependence and Independence of Solutions, Homogeneous linear ODEs with constant coefficients, Differential Operators Nonhomogeneous ODEs, Undetermined Coefficients, Variation of Parameters. | 10 | 22 |
| 2. | **Partial Differential Equation**<br>Formation of First and Second order equations, Solution of First order equations, Linear and Non-liner equations of first, Higher order equations with constant | 07 | 15 |

| | | | |
|---|---|---|---|
| | coefficients, Complementary function, Particular Integrals. | | |
| 3. | **Integral Transform-A**<br>Laplace Transform, Linearity, First Shifting Theorem, Existence Theorem, Transforms of Derivatives and Integrals, Unit Step Function, Second Shifting Theorem, Dirac's Delta function, Laplace Transformation of Periodic function, Inverse Laplace transform, Convolution | 06 | 13 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Integral Transform-B**<br>Introduction of Z transform, Linearity property, Damping rule, Basic theory of Z transform, Inverse Z-transform, Convolutions theorems, Application to Difference Equations | 09 | 21 |
| 2. | **Fourier Series**<br>Periodic function, Euler Formula, Arbitrary Period, Even and Odd function, Half-Range Expansions, Applications to ODEs. | 06 | 14 |
| 3. | **Fourier Integral and Transformation**<br>Representation by Fourier Integral, Fourier Cosine Integral, Fourier Sine Integral, Fourier Cosine Transform and Sine Transform, Linearity, Fourier Transform of Derivatives. | 07 | 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 | 4 |
| 4. | Partial Differential Equation-1 | 2 |
| 5. | Partial Differential Equation-2 | 4 |
| 6. | Laplace Transform | 2 |
| 7. | z-Transform-1 | 2 |
| 8. | z-Transform-2 | 2 |
| 9. | z-Transform-3 | 4 |
| 10. | Fourier Series-1 | 2 |
| 11. | Fourier Series-2 | 2 |
| 12. | Fourier Integral and Transformation | 2 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Advanced Engineering Mathematics | Erwin Kreyszig | Wiley India Pvt. Ltd. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Higher Engineering Mathematics | B. S. Grewal | Khanna Publishers |
| Advanced Engineering Mathematics | R. K. Jain, S.R.K. Iyengar | Narosa Publishing House Pvt. Ltd. |
| 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):**

1) http://nptel.ac.in/courses/111105035/
2) http://nptel.ac.in/courses/111106100/
3) http://nptel.ac.in/courses/111105093/
4) http://nptel.ac.in/courses/111108081/

**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

- grasp the respective 1st and 2nd order ODE and PDE.
- analyze engineering problems (growth, decay, flow, spring and series/parallel electronic circuits) using 1st and 2nd order ODE.
- classify differential equations and solve linear and non-linear partial differential equations.
- understand concepts, formulas, and problem-solving procedures to thoroughly investigate relevant real-world problems.

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

## Department of Chemical Engineering

Course Code: SECH2010
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 | |
| 03 | 00 | 01 | 04 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |

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 and unsteady 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 of units, 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. | 09 | 20 |

| | | | |
|---|---|---|---|
| 4. | **Material Balances:**<br>Materials balance: Concepts of limiting and excess reactants, Batch, Stage-wise, Continuous and recycle operations, Material balance of systems involving mixing, 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. | 10 | 20 |
| **Section II** | | | |
| Module No | Content | Hours | Weightage in % |
| 1. | **Vapour pressure:**<br>Vapour pressure plots, Vapour pressure of immiscible liquids and vapour pressure of solutions; Humidity and saturation humidity chart, Super saturation, Distribution of a solute between immiscible and partially miscible liquids, Solubility of gases. | 02 | 05 |
| 2. | **Thermo physics and Energy Balances:**<br>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. | 12 | 25 |
| 3. | **Multiple Unit Processes:**<br>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. | 07 | 20 |

**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

- know and understand the basics of Chemical Engineering calculations.
- interpret the data for Chemical Engineering process scenarios.
- apply the knowledge of the principles of Chemical Engineering reactions.
- enhance their technical skills in the form of numerical analysis.

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

**Department of Chemical Engineering**

Course Code: SECH2020
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 | |
| 03 | 02 | 00 | 04 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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. | 10 | 20 |
| 3. | **Properties of masses of solids**<br>Storage of solids: Angle of repose, bulk storage, storage in bins and silos. | 02 | 08 |
| 4. | **Conveying of solids** | 03 | 07 |

| | | | |
|---|---|---|---|
| | Codes for characterization of solids, screw conveyers, belt conveyers, bucket elevators, pneumatic conveying of solids, Design of conveyor belts, Mechanical and pneumatic conveying equipment and power consumption. | | |
| 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. | 05 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **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, constant rate 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. | 06 | 15 |
| 2. | **Gravity setting and sedimentation**<br>Gravity clarifiers, sorting clarifiers, Batch sedimentation, rate of sedimentation, 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. | 05 | 10 |
| 3. | **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. | 06 | 10 |
| 4. | **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. | 06 | 15 |

**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 behavior using different powder compaction models. | 02 |
| 5. | Study of particle size reduction by Roll crusher and Jaw crusher | 04 |
| 6. | Characterization of powder flow ability by Angle of Repose. | 04 |
| 7. | Obtaining the collection efficiency of cyclone | 02 |
| 8. | Obtaining settling rates of slurry as function of solid concentration | 02 |
| 9. | Power consumption in Agitated vessels | 02 |
| 10. | Study of froth flotation process | 02 |
| 11. | Study of Plate and Frame filter place | 04 |
| 12. | Study of Centrifugation process | 02 |

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

- understand the basic principles of particles preparation and their characterization.
- have an understanding of solid storage and their conveying in chemical process industries.
- have an understanding of design of sedimentation tanks and other solid fluid separation equipment.
- have knowledge about different size reducing equipment and power requirements during size reduction.
- develop an ability to design chemical engineering processes while including economic safety, environment and ethical consideration.

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

## Department of Chemical Engineering

Course Code: SECH2030
Course Name: Unit Processes in Organic Synthesis
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 | 20 | 30 | 00 | 00 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- develop an acumen for various chemical processes used in industries
- develop a mindset for various organic synthesis
- develop an acumen for design and development of process flow diagrams (PFDs) for various chemical processes

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction**<br>Definition and importance of unit processes in chemical engineering, Concept of unit operation and unit processes and their role in systematizing the cognitive structure of chemical industries, Classification of unit processes, Chemical process kinetics and Factors affecting, Symbols used in Chem. Engineering, Process flow diagram, Introduction to thermochemistry | 04 | 09 |
| 2. | **Nitration**<br>Introduction to nitration reactions, Nitrating agents, Aromatic Nitration, Kinetics and mechanism of aromatic nitration, Nitration of paraffinic hydrocarbon, Thermodynamics of nitration, Process equipment for technical nitration - schimid and Biazz nitrator, Mixed acid for nitration, D.V.S. value and nitric reaction, Comparison of batch Vs. Cont. nitration, Mfg. of Nitrobenzene, Dinitrobenzene, O-and P-Chloronitrobenzene, tri nitrotoluene. | 05 | 12 |

| | | | |
|---|---|---|---|
| 3. | **Amination by reduction**<br>Introduction to Amination reactions, Various methods of reductions and factors affecting it, Iron and acid (Bechamp) reduction, Batch and continuous process for manufacture of Aniline from Nitrobenzene, Continuous process for manufacturing of Aniline from nitrobenzene using catalytic fluidized bed reactor. | 05 | 11 |
| 4. | **Hydrogenation**<br>Definition and scope of hydrogenation, Hydrogen: production and properties, Gas catalytic hydrogenation and hydrogenlysis, Kinetics and thermodynamics of hydrogenation reactions, General principles concerning hydrogenation catalysts, Industrial hydrogenation of fat & oil, Production of methanol from $CO_2$ & $H_2$. Hydrogen production technologies and petroleum fractions. | 03 | 07 |
| 5. | **Oxidation**<br>Definition and Types of oxidative reactions, Oxidizing agents, Liquid phase oxidation with oxidizing compounds, Liquid-phase oxidation with oxygen, Oxidation of toluene with MnO2. Manufacturing of Acetaldehyde from Acetic acid and Manufacturing of Acetic acid from Ethanol; Vapor phase oxidation of Methanol, Benzene and Naphthalene, Apparatus and its M/s. for oxidation reactions. | 05 | 11 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Esterification and Hydrolysis**<br>Definition and scope of Esterification, Esterification by organic acids and by carboxylic acid derivatives, Esters by addition to unsaturated systems and inorganic acids, Definition and scope of hydrolysis, Hydrolyzing agents, Materials susceptible to hydrolysis, Kinetics, thermodynamics, and mechanism of hydrolysis, Equipment for hydrolysis with technical operations. | 03 | 06 |
| 2. | **Halogenation**<br>Definition and scope of halogenation reactions, Thermodynamics and kinetics of halogenation reactions Halogenating agents, Industrial halogenation with types of equipment, Manufacturing of Chlorobenzene, Benzene hexa-chloride and vinyl chloride from Ethylene and Acetylene. | 05 | 09 |
| 3. | **Sulfonation and sulfation**<br>Definition and scope of sulfonation and sulfation, Chemical and physical factors in sulfonation and sulfation, The desulfonation reaction, Use of $SO_3$, $SO_2$, $H_2SO_4$ as sulfonating and sulfating agents and their applications, Mfg. of Benzene sulfonates, Sulfation of Dimethyl Ether and Lauryl Alcohol. | 04 | 10 |

| | | | |
|---|---|---|---|
| 4. | **Amination by ammonolysis**<br>Definition & types of reactions, Aminating agents, Physical and Chemical factors affecting it. Catalyst used in ammonolysis, Kinetics and Thermodynamics of ammonolysis Mfg. of Aniline from chlorobenzene and Nitroaniline from Dichloro Nitro Aniline. | 04 | 08 |
| 5. | **Hydrolysis**<br>Definition and types of hydrolysis, Hydrolyzing agents, Kinetics, thermodynamics, and mechanism of hydrolysis, Industrial Hydrolysis of fat, hydrolysis of carbohydrates, starch to dextrose, Manufacturing of ethanol from ethylene (shell process) Mfg. of phenol from benzene sulfonic. | 05 | 09 |
| 6. | **Polymerization**<br>Introduction & chemistry of polymerization reactions, classifications of polymers methods of polymerization. | 02 | 08 |

**List of Practical:**

| Sr No | Name of Practical | Hours |
|---|---|---|
| 1. | Preparation of Urea-formaldehyde Resin | 02 |
| 2. | Synthesis of Phenol-formaldehyde Resin | 02 |
| 3. | Manufacturing of m-dinitrobenzene from Nitrobenzene | 04 |
| 4. | Determination of amount of benzoic acid in given sample | 04 |
| 5. | Residual Chlorine in water | 02 |
| 6. | Estimation of phenol by bromination | 04 |
| 7. | Determination of Ascorbic acid in a given sample | 04 |
| 8. | Determination of amount of acid neutralize capacity by given antacid sample | 02 |
| 9. | Preparation of Azo dye | 02 |
| 10. | Determination of oil absorption value of given pigment sample | 04 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Unit Processing of Organic Synthesis, 5th edition | Groggins P. H. | Tata-McGraw Hill, New Delhi, 2001 |
| Shreve's Chemical Process Industries, 5th Edition | Austin G. T | McGraw-Hill Pub., 1994. |
| Unit Processes in Organic Chemical Industries | Desikan, P and Sivakumar, T.C. | Chemical Engineering Education Development Centre, IIT Madras, 1982. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Dryden's Outlines of Chemical Tech. 2nd Ed. | Gopalarao. M. & Sitting M. | East-West Pub., New Delhi, 1997. |

| | | |
|---|---|---|
| Elementary Principles of Chemical Processes3rd ed. | Felder R.M., Rousseau R.W. | John Wiley, New York, 2000. |
| Riggel's Handbook of Industrial Chemistry | Kent J.A. | Van Nostrant Reinhold, 1974. |

**Web Material Link(s):**

- http://nptel.ac.in/courses/103107082/3

**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 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 consists of 15 marks during End Semester Exam.

**Course Outcome(s):**

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

- build a basic knowledge of the Fundamental structure of organic molecules and their manufacturing process.
- understand and explain the reactions in organic synthesis.
- correlate the same as per their utility in field of Chemical Engineering.
- understand the various Unit Processes and learn about the chemistry and organic compound.

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

## Chemical Engineering Materials & Metallurgy

Course Code: SECH2040
Course Name: Chemical Engineering Materials & Metallurgy
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 | 20 | 30 | 00 | 00 | 150 |

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. | 04 | 03 |
| 3. | **Properties of Materials**<br>Mechanical, Electrical and magnetic properties of materials, Selection of material like SS, Ti/Zr alloy and design for | 02 | 05 |

| | | | |
|---|---|---|---|
| | corrosion control, Factors determining the choice of materials of construction in chemical industries. | | |
| 4. | **Ferrous metals and its Alloys**<br>Iron and their alloys - Aluminium, copper, Zinc, lead, Nickel and their alloys with reference to the application in chemical 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. | 06 | 15 |
| 5. | **Non-Ferrous Alloys**<br>Non-Ferrous Alloys of Aluminium, Magnesium, Copper, Nickel, Titanium, Lead, Tin, Bearing metals, Zinc, Microstructure and mechanical property relationships. | -- | Laboratory |
| 6. | **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. | 05 | 12 |
| 7. | **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 and induction hardening, Carburizing, Nitriding and Carbonitriding, Applications of above processes for the industrial practices. | 04 | 08 |
| 8. | **Powder Metallurgy**<br>Application and advantages, Production of powder, Compacting, Sintering, Equipment and process capability. | -- | Laboratory |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **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 | 08 | 15 |

| | | | |
|---|---|---|---|
| | 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 in chemical 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. | | |
| 2. | **Membrane Materials and modules**<br>Membrane and their types, Membrane Materials, Modules and their types, method of preparation of various membranes, Industrial applications. | 04 | 10 |
| 3. | **Applications of advance materials in chemical Engineering**<br>Colloidal Materials and Their Industrial Applications, Surfactants, Mixed surfactants, Micelles, Vesicles, Micelles, Reverse micelles, Emulsions, Macroemulsions, foams, Thin Films, microbial polymers**,** green solvents, Industrial enzymes, Protein as Enzymes, Gels and Smart Hydrogels like Hydrogel, Core and shell hydrogel, shell and core hydrogel, green hydrogel, stimuli responsiveness hydrogel. | 06 | 15 |
| 4. | **Nano materials**<br>Metal and Semiconductor Nano materials, Quantum Dots, Wells and 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. | 04 | 10 |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1. | To understand construction and working of metallographic microscope. | 02 |
| 2. | To study procedure of specimen preparation for microscopic examination and to carry out a specimen preparation. | 04 |
| 3. | To understand what is micro examination, importance of micro examination and to study various ferrous, non-ferrous microstructures. | 04 |
| 4. | To show the effect of different quenching media like Oil, Water and Brine on the hardness of medium carbon steel. | 04 |
| 5. | To find out the effect of varying section size on hardenability of steel and obtain hardness distribution curves of hardened steel cross-section. | 04 |
| 6. | To determine machine defects by dye -penetrant test and magnetic particle test. | 04 |

| | | |
|---|---|---|
| 7. | To determine the hardenability by Jominy end quench test. | 04 |
| 8. | Study of different heat treatment processes- annealing, normalizing, hardening and tempering, surface and casehardening to improve properties of steel during processes and applications with the help of muffle furnace. | 04 |

**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.

**Practical/Tutorial:**

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

- interpret important chemical and mechanical properties and classification of engineering materials and metals.
- define different heat treatment process used in industrial applications.
- understand the different types of metals, alloys and chemical materials.
- analyze different microstructure, crystallography and defects of Chemical Engineering materials and metals.
- identify different destructive & non-destructive testing methods used in the practical field and their applications.
- understand the use powder metallurgy and their application to industries.

# P P Savani University
# School of Engineering

**Centre for Skill Enhancement & Professional Development**

Course Code: SEPD2010
Course Name: Critical Thinking, Creativity and Decision Making
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:**
To help learner to

- develop a familiarity with the mechanics of critical thinking and logic.
- understand basic concepts of critical and creative thinking.
- explore and understand critical thinking for the purpose of creativity in context of professional, social and personal spectrum.
- explore an application critical thinking and creativity in personal, social, academic, global and profession life.
- understand Decision making as a skill to be learned through critical thinking.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Critical Thinking**<br>• Concept and meaning of Critical Thinking<br>• Significance of Critical Thinking in personal, social and professional life<br>• Thinking with arguments, evidences and language | 08 | 25 |
| 2. | **Applied Critical Thinking**<br>• Inductive and Deductive Thinking<br>• Questioning for Generating Ideas<br>• Socratic Questioning and its application | 07 | 25 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Conceptual Thinking**<br>• Second order thinking | 03 | 10 |

| | | | |
|---|---|---|---|
| | • Synthesizing | | |
| 2. | **Creative Thinking and Decision Making**<br>• Problem Solving<br>• Adapting Various Structures of Decision Making | 06 | 20 |
| 3. | **Moral Thinking**<br>• Generating and structuring ideas<br>• Designing and Evaluating the solutions<br>• Case Study | 06 | 20 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Thinking Skills for Professionals | B. Greetham, Palgrave | Macmillan, 2010 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| An Introduction to Critical Thinking and Creativity: Think More, Think Better | J. Y. F. Lau | John Wiley & Sons., New Jercy |
| Critical Thinking: A Beginner's Guide to Critical Thinking, Better Decision Making and Problem Solving | Jennifer Wilson | CreateSpace Independent Publishing Platform, 2017 |
| Creativity and Critical Thinking | edited by Steve Padget | Routledge 2013 |

**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

- comprehend the concept and application of critical thinking as well as its applications.
- understand the critical thinking in context of creativity, logical arguments, moral reasoning.
- understand the application of critical thinking for social, academic, global and professional spectrum.
- correlate their thinking skills for better productivity and outcome-based tasks.
- in a better position to apply $360^{o}$ analysis of the situation for decision making.

**P P Savani University**

**Integrated Personality Development Course.**

Course Code: SEPD3040
Course Name: IPDC-1

**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 | 01 | 40 | 60 | 00 | 00 | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

To help learners to

- provide students with a holistic education – focused on increasing their intelligence quotient, physical quotient, emotional quotient and spiritual quotient
- provide students with hard and soft skills, making them more marketable when entering the workforce
- educate students on their social responsibilities as citizens of India
- provide students with a value-based education which will enable them to be successful in their family, professional, and social relationships.
- teach self-analysis and self-improvement exercises to enhance the potential of the participants.

**Course Content:**

| Lecture No. | Content | Hours | Weightage in % |
|---|---|---|---|
| 1. | • Remaking Yourself<br>- Restructuring Yourself. | 02 | 50 |
| 2. | • Remaking Yourself<br>- Power of Habit. | 02 | |
| 3. | • Remaking Yourself<br>-Developing Effective Habits. | 02 | |
| 4. | • Learning from Legends<br>- Tendulkar and Ratan Tata | 02 | |
| 5. | • From House To Home<br>Affectionate Relationship | 02 | |
| 6. | • Facing Failures<br>- Factors Affecting Failures. | 02 | 50 |
| 7. | • Facing Failures<br>- Failures are not Always Bad. | 02 | |
| 8. | • Facing Failures<br>- Insignificance of Failures. | 02 | |
| 9. | • Facing Failures<br>- Failures can be Overcome. | 02 | |
| 10. | • Learning from Legends<br>- Yogiji Maharaj and Nelson Mandela. | 02 | |

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of 40 marks. There will be a mid-term exam which will assess the current progress of students, it assessed out of 20 marks and will be equivalent to 20 marks of the Continuous Course Evaluation (CCE). There will be a submission consisting 10 marks as per the guidelines of course coordinator and average of the attendance consisting 10 marks (minimum 60 percentage attendance is required).
- End semester exam (ESE) part A 30 marks and part B 30 marks.

**Course Outcome(s)**

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

- have gained a greater sense of social responsibility
- have gained marketable hard and soft skills that would directly apply to their future careers
- have gained greater insight and ability to navigate their family, social, and professional relationships along with difficult situations which may arise in their life
- have a broader sense of self-confidence and a defined identity
- have greater value for living a moral and ethical life based on principles taught in the course

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

**Department of Civil Engineering**

Course Code: SECH2910
Course Name: Industrial Exposure
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 | 00 | 00 | 02 | 00 | 00 | 100 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective of the Course:**
To help learners to
- get exposed to the industrial spectrum.
- learn the mechanisms of industry/ workplace.
- be aware about work culture and policies of industries.

**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 |
| | **Grand Total:** | **100** |

**Course Outcome:**
After completion of the course, the student will be able to
- get acquainted with the industrial scenario.
- be aware about his future prospects in the respective field.
- gain knowledge of work culture and industrial expectations.

**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

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

**Department of Science & Humanities**

Course Code: SESH2022
Course Name: Numerical & Statistical Analysis
Prerequisite Course(s): SESH1020-Linear Algebra & Vector Calculus
SESH2031-Differential Methods for Chemical Engineers

**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 | 02 | 05 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |

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. | **Complex Variables**<br>Complex numbers with operators and geometric representation, Analytic function, Derivative of complex function, Cauchy-Riemann equation, Trigonometric and Hyperbolic functions, Complex Integration, Conformal Mapping, Linear functional transformations, Cauchy's Integral, Calculation of residue | 10 | 20 |
| 2. | **Numerical Solutions of Linear and Non-linear Equations**<br>Errors and Their computations, General error formula, Bisection Method, Iteration Method, Newton-Raphson Method, Solution of system of non-linear equation, Solution of linear system, Gauss Elimination | 6 | 13 |
| 3. | **Numerical Differentiation and Integration**<br>Interpolation, Finite Differences, Error in numerical differentiation, Cubic Splines Method, Differentiation Formulae, Numerical solution of ODEs, Picard's Method, Euler's Method, Runge-Kutta Method, Numerical Integration, | 7 | 17 |

| | | | |
|---|---|---|---|
| | Trapezoidal Rule, Simpson's 1/3-rule, Simpson's 3/8-rule, Euler-Maclaurin Formulae | | |
| **Section II** | | | |
| Module | Content | Hours | Weightage in % |
| 1. | **Basics of Statistics**<br>Elements, Variables, Observations, Quantitative and Qualitative data, Corss-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 Analysis, Regression line and regression coefficient, Karl Pearson's method | 7 | 15 |
| 2. | **Probability Distribution**<br>Introduction, Conditional probability, Independent events, independent experiments, Theorem of total probability and Bayes' theorem, Probability distribution, Binomial distribution, Poisson distribution, Uniform distribution, Normal distribution. | 8 | 18 |
| 3. | **Testing of Hypothesis**<br>Introduction, Sampling, Tests of significance for parametric test, Null Hypothesis, Type 1 and Type 2 errors, Level of significance, Chi-square test, Student's t-test, Seducer's f-test | 7 | 17 |

**List of Tutorials:**

| Sr. No. | Name of Tutorial | Hours |
|---|---|---|
| 1. | Complex Variables-1 | 4 |
| 2. | Complex Variables-2 | 2 |
| 3. | Numerical Solutions of Linear and Non-linear Equations-1 | 2 |
| 4. | Numerical Solutions of Linear and Non-linear Equations-2 | 4 |
| 5. | Numerical Differentiation and Integration-1 | 2 |
| 6. | Numerical Differentiation and Integration-2 | 2 |
| 7. | Basics of Statistics-1 | 2 |
| 8. | Basics of Statistics-2 | 4 |
| 9. | Probability-1 | 2 |
| 10. | Probability-2 | 2 |
| 11. | Testing of Hypothesis-1 | 2 |
| 12. | Testing of Hypothesis-2 | 2 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Advanced Engineering Mathematics | Erwin Kreyszig | Wiley India Pvt. Ltd. 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 |
|---|---|---|
| Higher Engineering Mathematics | 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. |

**Web Material Link(s):**

- http://nptel.ac.in/courses/111106094/
- http://nptel.ac.in/courses/111106084/
- http://nptel.ac.in/courses/111105035/
- http://nptel.ac.in/courses/111101003/
- http://nptel.ac.in/courses/111105090/

**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

- derive numerical solution of linear and non-linear system of equation.
- acquire knowledge of finite differences, interpolation, numerical differentiation and numerical integration.
- select appropriate method to collect data and construct, compare, interpret and evaluate data by different statistical methods.
- apply concept of probability in decision making, artificial intelligence, machine learning etc.

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

**Department of Chemical Engineering**

Course Code: SECH2050
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 | 00 | 04 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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 is used 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 the loss 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, | 04 | 10 |

| | | | |
|---|---|---|---|
| | 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. | | |
| 3. | **Boundary layers & its applications**<br>Concept of Boundary Layer, Boundary layer Thickness, Momentum Thickness, Displacement Thickness, Drag and Lift, Separation of Boundary 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 and Non Uniform Flow, Rotational and Irrotational Flow, Stream Lines and Stream Function, Velocity Potential Function, Relation between stream 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 – Dracy Weishbach 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, Drag reduction 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 % |
| 1. | **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 |
| 2. | **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 |
| 3. | **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, Area meters; Head meters; Mass flow meter; Hot-wire anemometer, Hot wire and hot film anemometers. | 06 | 15 |
| 4. | **Applications of fluid mechanics** | 06 | 15 |

| | | | |
|---|---|---|---|
| | Pipe, fitting and valves, pumps, compressor, blowers and fans, Flow past immersed bodies: Drag, Drag coefficients, Flow through beds of solids, Particle motion, Terminal velocity, Hindered settling, Settling and 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). | | |

**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 |

**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/Tutorial:**

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

- understand fundamentals of fluids.
- analyze various flow problems and flow characteristics.
- determine major and minor losses through different pipes.
- apply the concept of fluid mechanics to design various system.

**P P Savani University**

**School of Engineering**

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**Department of Chemical Engineering**

Course Code: SECH2061

Course Name: Physical Inorganic and Analytical Chemistry

Prerequisite Course(s): 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 | 00 | 04 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

To help learner to

- provide the basic knowledge of physical, inorganic and analytical chemistry to students in the context of industrial need to make a good foundation in Chemistry which will help to the students in their self-development and to cope up with industries need.
- understand the basics of different chemistry
- make them aware about various analytical techniques used for the analysis of chemical substances
- use physical chemistry and its theoretical principles and experimental techniques to investigate the chemical transformations and Physical changes accompanying them.
- make them aware about the inorganic chemistry and its qualitative analysis.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Properties of Liquid and preparation of solution**<br>Define the terms: Solute, Solvent and Solution, Different standards of solutions like Primary standards and Secondary standards, Definition and different methods of expressing concentration, Definition of the Surface tension, Parachor, Refractive index, Molar refraction, Specific refraction, Viscosity. | 02 | 04 |
| 2. | **Electro analytical techniques for analysis**<br>Basic concepts, Standard reduction potentials, Measurement of overall redox reaction tendency, Introduction to Potentiometry, Electrodes (Reference electrode, Saturated calomel reference electrode, indicator electrode, pH electrode), potentiometric titration, Karl Fischer titration (End point detection, The coulometric method) | 06 | 14 |

| | | | |
|---|---|---|---|
| 3. | **Phase Rule**<br>Introduction, Phase Rule and its merits and demerits, Phase diagrams of single component systems ($H_2O$ and Sulphur), two component systems involving eutectic systems (Pb-Ag, Sn-Mg), Applications. | 03 | 07 |
| 4. | **Nuclear Chemistry**<br>Basic terms and concepts, Types of nuclear reactions, Nuclear fission and fusion, nuclear reactors, radiation measurements (Detectors- Gas ionization detectors- principle, Ion chambers-proportional counter, G.M. Counter-scintillation detector-principle, features, Inorganic & organic scintillators, solid state detectors), disposal of nuclear waste. | 05 | 11 |
| 5. | **Emerging Trends in Green Chemistry**<br>Introduction to Green Chemistry, Twelve principles of Green Chemistry with examples, Designing a Green Synthesis, Example of green synthesis (adipic acid, catechol, Methyl Methacrylate). | 02 | 04 |
| 6. | **Microscopy Techniques**<br>Principles, Instrumentation, Analysis of images/artifacts, Applications, AFM (Atomic force microscopy), SEM (Scanning electron microscope), TEM (Transmission electron microscopy), FTIR. | 04 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Corrosion and its Control**<br>Introduction and theories of corrosion, Dry corrosion (chemical), Wet corrosion (electrochemical), Bio corrosion, Mechanism of corrosion, Factors influencing corrosion (ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium – pH, conductivity, and temperature), Corrosion control and prevention methods, corrosion inhibitors, cathodic and anodic protection and Electroplating. Protective coatings, chemical principles involved, boiler corrosion, inter granular corrosions. | 07 | 17 |
| 2. | **Instrumental Methods Of Chemical Analysis: Spectroscopic methods**<br>Basic concepts, Instrumentation, Interpretation of data and relevant applications, Ultraviolet spectroscopy (UV), Infrared spectroscopy (IR), Nuclear Magnetic Resonance (NMR), Mass Spectrometry. | 06 | 13 |
| 3. | **Thermal methods of analysis**<br>TGA, DTA, DSC (Principle, Instrumentation, Quantitative aspects of curves and/or Interpretation of curves, Applications) | 05 | 10 |
| 4. | **Separation Techniques** | 05 | 10 |

| | | | |
|---|---|---|---|
| | Principle, Instrumentation, selection of column and its specifications, applications and Limitations, Planar Chromatography (Paper chromatography, Thin Layer Chromatography), Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC) | | |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1. | To determine the strength of the given Hydrochloric acid by Sodium hydroxide conduct metrically. | 04 |
| 2. | To synthesize Chrome Alum. | 04 |
| 3. | To determine λmax and concentration of unknown solution of KMnO4 in 2N H2SO4 using Colorimeter. | 04 |
| 4. | Determine the amount of $Ba^{2+}$ as $BaSO_4$ in a salt solution. | 04 |
| 5. | To investigate the reaction between $K_2S_2O_8$ and KI. | 04 |
| 6. | Conductometric titration of strong acid vs. strong base. | 04 |
| 7. | Determination of dissociation constant of weak acid by pH metric method. | 04 |
| 8. | Determination of cloud point of a surfactant in the presence of salts. | 02 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Text Book of Engineering Chemistry | Chawla S. | Dhanpat Rai & Co. Pvt. Ltd., Delhi, 2003. |
| Engineering Chemistry | Sharma B. K. | Krishna Prakashan Media (P) Ltd, Meerut.,2001 |
| Instrumental Methods of Chemical Analysis | Ewing G. W. | Tata-McGraw Hill., New Delhi, 2001. |
| Basis Concept of Analytical Chemistry | Khopkar S. M. | New Age International Publishers, 1998. |
| A Text Book of Quantitative Chemical Analysis | Vogel A. I. | ELBS UK, 5th Edition, 1996. |
| A Text Book of Polymer Science | Billmeyer F. W. | Wiley Interscience, New York, 3rd ed., 1984. |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Analytical Chemistry for Technicians (4th edition) | John Kenkel | CRC Press, Taylor & Francis Group |
| Corrosion Engineering Principles and Practice | Pierre R. Roberge | The McGraw-Hill Companies |
| New-Trends-in-Green-Chemistry | V. K. Ahluwalia, M.Kidwai | Kluwer Academic Publishers, Boston Dordrecht London & Anamaya Publishers, New Delhi |
| Atomic Force Microscopy | Peter Eaton | Oxford University Press |

| | | |
|---|---|---|
| Fundamentals of Atomic Force Microscopy | Ronald G. Reifenberger | World Scientific Publishing Co |
| Principles and Practice of Modern Chromatographic Methods | Robards K., Jackson P., Haddad P A. | Elsevier Academic Press |
| Fundamentals of Analytical Chemistry | Douglas A. S., Donald M. W., Holler H. J., Crouch H. R. | Brooks Cole; 9th edition |
| Introduction to Spectroscopy | Donal L. P., Gary M. L., George S. K. , James A. V. | Brooks Cole |

**Web Material Link(s):**
http://nptel.ac.in/courses/105104148/

**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 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 consists of 15 marks during End Semester Exam.

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

- familiarize him/herself with the basics of different chemistries used in chemical industries.
- have theoretical and practical knowledge about modern analytical techniques and its quantitative analysis.
- able to perform in industry for various analytical tools.

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

**Department of Chemical Engineering**

Course Code: SECH2070
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 | |
| 03 | 00 | 01 | 04 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |

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 of Change (dU, dH, dA, dG). | 07 | 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. | 07 | 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:**<br>Phase diagrams for miscible, partially miscible and immiscible liquid mixtures, introduction to LLE and VLLE calculations. | 04 | 15 |

| | Section II | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Thermodynamic Properties of Solutions:** Introduction to fugacity and activity, Activity Coefficients- Partial 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, $C_p$, $C_v$, 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 | 16 | 30 |
| 2. | **Refrigeration and liquefaction:** Carnot refrigerator, Vapour compression cycle, Absorption refrigeration, Choice of refrigerant, Heat pump, Liquefaction processes. | 06 | 20 |

**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). |

**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.

**Practical/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 completion of the course, the student will be able to

- calculate enthalpies, entropies and free energies of real gases from (a) equations of state (b) measured quantities
- calculate saturation pressure and latent heats of vaporization from cubic equations of state.
- able to correlate experimental VLE data of pure component and ideal mixtures with suitable equations.
- enhance their technical skill in the form of numerical analysis.

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

**Department of Chemical Engineering**

Course Code: SECH2080
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 | 00 | 04 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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 mass transfer | 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 for gases, 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, Dimensionless groups 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 No. | Content | Hours | Weightage in % |
| 1. | **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 |
| 2. | **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 – direct and indirect driers, Continuous driers – direct and indirect driers, selection of driers. | 07 | 20 |
| 3. | **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 |

**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 |

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

- familiar with the basic phenomenon of mass transfer involving phases.
- able to apply the mathematical and design concepts of mass transfer in gas liquid systems like absorption, humidification, drying and crystallization.
- gaining good knowledge of required optimum condition for a gas-liquid system.
- familiar with fundamentals of thermodynamics as applied to various processes.
- understand the properties as applied to ideal and real gases.
- understand the equilibrium states for mixture of gases, phases and chemical reaction.
- verify the fundamentals learnt viz., application of thermodynamic laws, solution thermodynamics, phase equilibrium and reaction equilibrium in Chemical Engineering thermodynamics by conducting experiments and carry out the evaluation.

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

**Centre for Skill Enhancement & Professional Development**

Course Code: SEPD2020
Course Name: Values and Ethics
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:**
To help learner to:

- develop a familiarity with the mechanics of values and ethics.
- understand basic concepts of values and ethics
- explore and understand values, ethics in context of professional, social and persona spectrum
- explore an understand values, ethics in context of globalization and global issues
- explore an application of values and ethics in personal, social, academic, global and professional life.
- to facilitate the learners to understand harmony at all the levels of human living and live accordingly.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Values**<br>• Definition and Concept<br>• Types of Values<br>• Values and its Application | 03 | 10 |
| 2. | **Elements and Principles of Values**<br>• Universal & Personal Values<br>• Social, Civic & Democratic Values<br>• Adaptation Models & Methods of Values | 06 | 20 |
| 3. | **Values and Contemporary Society**<br>• Levels of Value Crisis<br>• Value Crisis Management<br>• Values in Indian Scriptures | 06 | 20 |

| Section II | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Ethics and Ethical Values**<br>• Definition and Concept<br>• Acceptance and Application of Ethics<br>• Ethical Issues and Dilemma<br>• Universal Code of Ethics: Consequences of Violation | 07 | 25 |
| 2. | **Applied Ethics**<br>• Professional Ethics<br>• Organizational Ethics<br>• Ethical Leadership<br>• Ethics in Indian Scriptures | 08 | 25 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Values and Ethics in Business and Profession | By Samita Manna, Suparna Chakraborti | PHI Learning Pvt. Ltd., New Delhi, 2010 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Just a Job?: Communication, Ethics, and Professional life | George Cheney | Oxford University Press, 2010 |
| Professional Ethics and Human Values | M. Govindarajan, S. Natarajan, V. S. Senthilkumar | PHI Learning Pvt. Ltd, 2013 |
| Creating Values In Life: Personal, Moral, Spiritual, Family and Social Values | By Ashok Gulla | Author House, Bloomington, 2010 |
| **E-Book(s)** | | |
| • Ethics for Everyone, Arthur Dorbin, 2009. (http://arthurdobrin.files.wordpress.com/2008/08/ethics-for-everyone.pdf)<br>• Values and Ethics for 21st Century, BBVA. (https://www.bbvaopenmind.com/wp-content/uploads/2013/10/Values-and-Ethics-for-the-21st-Century_BBVA.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.

**Course Outcomes:**

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

- understand and relate the concepts and mechanics of values and ethics in their life.

- correlate the significance of value and ethical inputs in and get motivated to apply them in their life and profession.
- realize the significance of value and ethical inputs in and get motivated to apply them in social, global and civic issues.
- learn to apply such principles with reference to Indian scriptures.

## P P Savani University

## Integrated Personality Development Course

Course Code: SEPD3050
Course Name: IPDC-2

**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 | 01 | 40 | 60 | 00 | 00 | -- | -- | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

To help learners to

- provide students with a holistic education – focused on increasing their intelligence quotient, physical quotient, emotional quotient and spiritual quotient.
- provide students with hard and soft skills, making them more marketable when entering the workforce.
- educate students on their social responsibilities as citizens of India
- provide students with a value-based education which will enable them to be successful in their family, professional, and social relationships.
- teach self-analysis and self-improvement exercises to enhance the potential of the participants.

**Course Content:**

| Lecture No. | Content | Hours |
|---|---|---|
| 1. | Remaking Yourself<br>Restructuring Yourself. | 02 |
| 2. | Essentials of Profession<br>Writing a Resume | 02 |
| 3. | Financial Wisdom<br>Basics of Financial Planning. | 02 |
| 4. | Financial Wisdom<br>Financial Planning Process. | 02 |
| 5. | From House to Home<br>Listening & Understanding. | 02 |
| 6. | From House to Home<br>Forgive & Forget. | 02 |
| 7. | From House to Home<br>Bonding the Family. | 02 |
| 8. | Soft Skills<br>Networking, Decision making & Leadership | 02 |

| | | |
|---|---|---|
| 9. | Soft Skills<br>Teamwork, Harmony & Adaptability. | 02 |
| 10. | Mass Management<br>Project Management. | 02 |
| 11. | My India My Pride<br>Glorious Past (Part -1) | 02 |
| 12. | My India My Pride<br>Glorious Past (Part -2) | 02 |
| 13. | My India My Pride<br>Present Scenario. | 02 |
| 14. | My India My Pride<br>An Ideal Citizen-1 | 02 |
| 15. | My India My Pride<br>An Ideal Citizen-2 | 02 |

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

- Continuous Evaluation consists of 40 marks. There will be a mid-term exam which will assess the current progress of students, it assessed out of 20 marks and will be equivalent to 20 marks of the Continuous Course Evaluation (CE). There will be a submission consisting 10 marks as per the guidelines of course coordinator and average of the attendance consisting 10 marks (minimum 60 percentage attendance is required).
- End semester exam (ESE) section I (30 marks) and section II (30 marks).

**Course Outcome(s):**

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

- have gained a greater sense of social responsibility.
- have gained marketable hard and soft skills that would directly apply to their future careers.
- have gained greater insight and ability to navigate their family, social, and professional relationships along with difficult situations which may arise in their life.
- have a broader sense of self-confidence and a defined identity.
- have greater value for living a moral and ethical life based on principles taught in the course.

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

**Center for Skill Enhancement and Professional Development**

Course Code: SEPD3030
Course Name: German Language
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:**
To help learner to

- to develop and integrate the use of the four language skills i.e. listening, speaking, reading and writing.
- use the language effectively and appropriately on topics of everyday life situations.
- develop an interest in the appreciation of German.
- to develop an intercultural awareness.
- to enhance the ability of the candidates to express their ideas and feelings in their own words and for them to understand the use of correct language.
- to appreciate the language as an effective means of communication.
- understand language when spoken at normal conversational speed in everyday life situations.
- understand the basic structural patterns of the language, vocabulary and constructions.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to German**<br>Alphabets, German accents<br>• German Numbers<br>• What are the similarities and differences between English and German?<br>• Greetings | 2 | 15 |
| 2. | **German Time**<br>• Basic Introduction | 2 | 08 |
| 3. | **Vocabulary part-1**<br>• The days of the week<br>• The months of the year<br>• Seasons<br>• Directions<br>• Weather | 2 | 05 |

| | | | |
|---|---|---|---|
| 4. | **Vocabulary part-2**<br>• Family<br>• Colors and Shapes<br>• Day/time indicators<br>• Body parts<br>• Clothing | 2 | 07 |
| 5. | **Vocabulary Part-3**<br>• Food and Meals<br>• Fruits, Vegetables and Meats<br>• Sports and Hobbies | 2 | 05 |
| 6. | • Transportation<br>• House and Furniture | 2 | 05 |
| 7. | • School Subject<br>• Places<br>• Common Expressions | 2 | 05 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **German grammar**<br>• Verb Sein (to be)<br>• Verb Haben (to have)<br>• Introduction of Regular verbs and Irregular verb<br>• Konjugation of Regular verb<br>• First group verbs('EN' group) | 2 | 10 |
| 2. | • Konjugation of Regular verbs<br>• Second group verbs('Ten/Den' group)<br>• Konjugation of Irregular verbs<br>• Third group verbs (Stem change verb)<br>• Fourth group verbs (Spell Change Verb) | 2 | 10 |
| 3. | • Nicht trennbare und trennbare Verben<br>• Die Modalverben<br>• Personalpronomen-Nominativ | 2 | 10 |
| 4. | • W-Frage<br>• Ja/Nein-Fragen<br>• Nomen und Artikel-Nominativ<br>• Die Anrede | 2 | 10 |
| 5. | • Nomen-Genusregein<br>• Adjektiv<br>• Nomen und Artikel-Akkusativ<br>• Personalpronomen-Akkusativ | 2 | 10 |
| 6. | • Practice of Writing<br>• Practice of Speaking | 2 | - |
| 7. | • Practice of Listening | 2 | - |
| 8. | • Practice of Reading | 2 | - |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Namaste German | Yoshita Dalal | Yoshita Dalal |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| **Fit In Deutsch** | **Hueber** | **Goyal Publication** |

**Web Material Links:**

- https://www.youtube.com/watch?v=iGovllrEsF8&list=PLRps6yTcWQbpoqIOCmqMeI1HLnLIRmO_t
- https://www.youtube.com/watch?v=GwBfUzPCiaw&list=PL5QyCnFPRx0GxaFjdAVkx7K9TfEklY4sg

**Course Evaluation:**

**Theory:**

- Continuous Evaluation consists of an Internal Exam of 30 marks.
- German Speaking Exam consists of 10 marks.
- End Semester Examination consists of 60 Marks exams.

**Course Outcome(s):**

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

- demonstrate speaking, reading, writing and listening in German.
- understand German Technology.
- communicate easily in four Language and they can get good job in German Company.
- demonstrate the level of proficiency necessary to enable them to function in an environment where German is used exclusively.

# THIRD YEAR B. TECH.

| P P SAVANI UNIVERSITY | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCHOOL OF ENGINEERING | | | | | | | | | | | | | | |
| TEACHING & EXAMINATION SCHEME FOR B.TECH. THIRD YEAR CHEMICAL ENGINEERING PROGRAMME | | | | | | | | | | | | | | |
| Sem | Course Code | Course Name | Teaching Scheme | | | | | Examination Scheme | | | | | | |
| | | | Contact Hours | | | | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | Theory | Practical | Tutorial | Total | | CE | ESE | CE | ESE | CE | ESE | |
| 5 | SECH3010 | Heat Transfer Operations | 4 | 2 | 0 | 6 | 5 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH3021 | Mass Transfer Operations - II | 4 | 2 | 0 | 6 | 5 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH3030 | Instrumentation & Process Control | 4 | 2 | 0 | 6 | 5 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH3041 | Chemical Engineering Thermodynamics-II | 4 | 0 | 2 | 6 | 6 | 40 | 60 | 0 | 0 | 20 | 30 | 150 |
| | SEPD3010 | Professional Communication & Soft Skills | 1 | 2 | 0 | 3 | 2 | 0 | 0 | 50 | 50 | 0 | 0 | 100 |
| | Elective-I | | 3 | | | 3 | 3 | | | | | | | 150 |
| | SECH3910 | Summer Training | 4 | | | 0 | 4 | 0 | 0 | 100 | 0 | 0 | 0 | 100 |
| | **Total** | | | | | **31** | **30** | | | | | | | **950** |
| 6 | SECH3053 | Chemical Reaction Kinetics-I | 4 | 2 | 0 | 6 | 5 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH3062 | Process Equipment & Design-I | 4 | 4 | 0 | 8 | 6 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH3071 | Chemical Process Technology | 4 | 2 | 0 | 6 | 5 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SEME4021 | Renewable Energy System | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SEPD3020 | Corporate Grooming & Etiquette | 1 | 2 | 0 | 3 | 2 | 0 | 0 | 50 | 50 | 0 | 0 | 100 |
| | Elective-II | | 3 | | | 3 | 3 | | | | | | | 100/ 150 |
| | **Total** | | | | | **32** | **25** | | | | | | | **800/ 850** |

| Elective Courses | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Offered from Sem. | Course Code | Course Name | Offered By | Teaching Scheme | | | | | Examination Scheme | | | | | | | |
| | | | | Contact Hours | | | | Credit | Theory | | Practical | | Tutorial | | Total |
| | | | | Theory | Practical | Tutorial | Total | | CE | ESE | CE | ESE | CE | ESE | |
| 5 | SECH3510 | Pharma Technology – API & Formulation | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3520 | Process Auxiliaries & Utilities in Allied Industries | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3530 | Air Pollution & Control | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3540 | Polymer Science & Technology | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| 6 | SECH3550 | Computational Methods In Chemical Engineering (Sci-Lab/Octave/Matlab) | CH | 2 | 2 | 0 | 4 | 3 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH3560 | Environmental Issues, Waste Management & EIA | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3570 | Fundamentals to Dyes & Pigment | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH3580 | Processing in Agrochemical, Food Industries & Biochemical 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: SECH3010
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 | |
| 04 | 02 | 00 | 05 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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 Contact Resistance, Steady State Heat Conduction through a Variable Area – Cylinder & Sphere, Heat Conduction in Bodies with Heat Sources. | 05 | 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 & Separated by a Cylindrical Wall, Enhanced Heat Transfer: Concept of Fins - Analytical Solution of Different Cases and Fin Efficiency, Thermal Insulation. | 08 | 15 |

| | | | |
|---|---|---|---|
| 4. | **Forced Convective Heat Transfer**<br>Principle of Convection, Forced Convection Mechanism: Flow over a Flat Horizontal Plate**,** Flow through a Pipe or Tube - Turbulent 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 and Heat Transfer Analogies - Reynolds Analogy, The Chilton-Colburn Analogy, The Prandtl Analogy, The Van Karman Analogy. | 08 | 10 |
| 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. | 06 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **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. | 08 | 10 |
| 2. | **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 |

| | | | |
|---|---|---|---|
| 3. | **Heat Exchangers**<br>Elements of Shell and Tube Heat Exchanger, Thermal Design of Heat Exchangers - 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 | 10 | 20 |
| 4. | **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 Tubular Evaporators - 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. | 06 | 10 |

**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 |

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

- understand basic concept of heat transfer.
- understand and solve conduction, convection and radiation problems.
- design and analyze the performance of heat exchangers and evaporators.
- design and analyze reactor heating and cooling systems.
- apply scientific and engineering principles to analyze and design aspects of engineering.
- understand systems that relate to conduction, convection and radiation heat transfer.

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

**Department of Chemical Engineering**

Course Code: SECH3021
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 | |
| 04 | 02 | 00 | 05 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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>Introduction, Vapor-Liquid Equilibria, P-x-y and T-x-y Diagrams, Effect of Pressure and Temperature, Relative Volatility, Ideal solutions, Rault's law, Positive Deviation, Minimum Boiling Azeotrope, Negative Deviation, Maximum | 10 | 20 |

| | | | |
|---|---|---|---|
| | Boiling Azeotrope, Types of Distillation: Flash, Steam, Simple, Batch Fractionation, Continuous Rectification, Derivation for Enriching and Stripping Section, q Line Equation, Mc-Cabe Thiele method, Concept of Minimum, Total and Optimum Reflux Ratio, Reboilers, Total and Partial Condensers, Use of Open Steam, Cold and Hot Reflux, Enthalpy Concentration Diagrams and their Characteristics, Determination of Number of Stages by Ponchon and Savarit method, Azeotropic distillation, Extractive Distillation, Numerical. | | |
| 2. | **Liquid - Liquid Extraction**<br>Liquid-liquid Extraction and their Industrial applications, Mixture Rule, Ternary Diagram, Extraction systems Effect of Temperature and Pressure Plotting the Binodal Curve, Solvent Selection Criteria, Cross and Counter current Extraction, Multistage Counter current Extraction with and without Reflux, ΔR point, Equipment for Extraction, Numerical. | 10 | 15 |
| 3. | **Gas Absorption**<br>Gas Absorption, Equilibrium solubility, Ideal and Non ideal solutions, Solvent Selection Criteria, Material Balance Counter Current Operations, Continuous Contact equipment, HETP, HTU, NTU, Absorption with chemical reactions, Gas Liquid Contacting equipment, Mechanical Mixing, Agitators, Tray towers and its internals, Coning ,Weeping, Loading and Flooding, Types of Trays e.g. Bubble cap, Sieve tray etc., Tray diameter, Spacing, Flow Pattern, Venturi Scrubbers, Packed tower, Types of packings and selection criteria, Numerical. | 10 | 15 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Equipment for Gas-Liquid Operations**<br>Gas Dispersed – Spray Vessels (Bubble Columns), Mechanically Agitated Vessels, Mechanical Agitation of Single-Phase Liquids, Mechanical Agitation (Gas Liquid Contact), Tray Towers Liquid Dispersed – Venturi Scrubber, Wetted-Wall Towers, Spray Towers and Spray Chambers, Packed Towers, Co-current Flow of Gas and Liquid, End Effects and Axial Mixing, Tray Towers vs Packed Towers. | 08 | 15 |
| 2. | **Adsorption and Ion Exchange**<br>Introduction, Types of Adsorption, Nature of Adsorption, Industrial Adsorbents, Adsorption Equilibria, Adsorption Hysteresis, Effect of temperature, Heat of Adsorption, Adsorption of Solute from Dilute Solutions, Applications of Freundlich Isotherm, Adsorption from Concentrated Solutions, Stage wise Operations Contact Filtration of Liquids, | 10 | 25 |

| | | | |
|---|---|---|---|
| | Single Stage, Cross Current Operations and Application of Freundlich Isotherm, Multistage Counter Current Operations, Fixed bed Absorbers, Adsorption wave, Adsorption of Vapors, Industrial Applications of Adsorption and the Equipment, Rate of Adsorption in Fixed Beds, Numerical. | | |
| 3. | **Leaching**<br>Leaching, Preparation of Solids, Unsteady State Operations, Steady State (Continuous) Operation, Leaching Equipment, Single Stage and Multistage Leaching Cross and Counter Current Leaching, Method of Calculations, Numerical. | 06 | 10 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | York Scheibel's Extraction Unit | 04 |
| 2. | Simple Batch Distillation unit | 04 |
| 3. | Absorption in sieve plate column | 04 |
| 4. | Fluidized Bed dryer | 04 |
| 5. | Adsorption in packed bed | 04 |
| 6. | Sieve Plate distillation column | 04 |
| 7. | Vapor-Liquid Equilibrium Set-up | 04 |
| 8. | Membrane Separation Unit | 02 |

**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 completion of the course, the student will be able to
- understand the various types of unit operations such as distillation, adsorption, extraction, leaching etc.
- solve problems in adsorption using theory of mass transfer as applied to adsorption columns.
- understand main categories of equipment for gas/liquid mass transfer.
- design plate columns and packed columns for adsorption or desorption or regeneration.
- understand the various methods for calculation no. of plates required in distillation column.
- apply the principles of vapor liquid equilibrium in solving distillation problems.

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

**Department of Chemical Engineering**

**Course Code:** SECH3030
**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 | |
| 04 | 02 | 00 | 05 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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 No. | Content | Hours | Weightage in % |
| 1. | **Introduction to process control**<br>Process control system, Variable physical element of process control system, Modelling of a process. | 02 | 05 |
| 2. | **Laplace Transforms**<br>Properties of Laplace transforms, Solution of linear | 06 | 05 |

| | | | |
|---|---|---|---|
| | differential equation using Laplace transform techniques, Dynamic behavior of systems, Transfer functions | | |
| 3. | **Dynamic behavior of chemical processes**<br>Analysis of first order system with different forcing functions, Analysis of second & higher order system, Components of feedback control system. | 08 | 15 |
| 4. | **Modes of control action**<br>Controllers and final control elements, closed loop transfer function and block diagram algebra. | 06 | 10 |
| 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. | 8 | 15 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Advanced Control Schemes**<br>Feedback control of systems with dead time or inverse response, Control systems with multiple loops, Feed forward and Ratio control. | 08 | 15 |
| 2. | **Process Control Using Digital Control**<br>Digital Computer control loops, Continuous time to discrete time systems, Z-transform to inverse Z-transform, Response of discrete dynamic system, discrete time analysis & closed loop systems. | 10 | 10 |
| 3. | **Piping & Instrumentation (P&I) diagram**<br>Symbols, P&I Diagram of reactors, Distillation column, Shell & tube heat exchanger etc. | 02 | 02 |
| 4. | **Introduction of Process Measurement**<br>Elements of instruments, Parts of instruments, Static and dynamic characteristics. | 02 | 03 |
| 5. | **Measuring devices for flow, temperature, pressure and level.** | 08 | 20 |

**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 |

**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. and Mellichamp, D.A. | 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 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 completion of the course, the student will be able to

- understand the basic principles & importance of process control in industrial process plants.
- specify the required instrumentation and final elements to ensure that well-tuned control is achieved.
- understand the use of block diagrams & the mathematical basis for the design of control systems.
- design and tune process (PID) controllers.

- understand the importance and application of good instrumentation for the efficient design of process control loops for process engineering plants.

## P P Savani University
## School of Engineering

### Department of Chemical Engineering

Course Code: SECH3041
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 | |
| 04 | 00 | 02 | 06 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |

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. | 6 | 10 |
| 2. | **Gibbs-Duhem Equation**<br>General form, Various forms of Gibbs-Duhem equation, Applications, Limitations, Property changes of mixing, Excess Properties. | 10 | 15 |
| 3. | **Criteria of Phase Equilibrium**<br>Duhem theorem, Vapour liquid equilibrium, VLE equation, Low pressure VLE, Phase diagrams for binary solution, T-x-y and P- | 8 | 15 |

| | | | |
|---|---|---|---|
| | x-y diagrams, Effect of pressure on VLE, Azeotropes and its types. | | |
| 4. | **Activity Coefficient**<br>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. | 6 | 10 |

| Section II | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Solution Thermodynamics**<br>Fundamental Property Relation, The Chemical Potential as a Criterion for Phase Equilibria, Partial Properties, Equations Relating Molar and Partial Molar Properties , The Partial Molar Gibbs Energy and the Generalized Gibbs-Duhem Equation, Partial Properties in Binary Solutions, Relations among Partial Properties, The Ideal Gas Mixture , The Partial Molar Gibbs Energy and Fugacity, Fugacity and Fugacity Coefficient: Pure Species, Fugacity and Fugacity Coefficient: Species in Solution ,The Ideal Solution Model , The Lewis/Randall Rule , Excess Properties , The Excess Gibbs Energy and the Activity Coefficient, Nature of Excess Property, | 8 | 18 |
| 2. | **Liquid Phase Properties**<br>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 Method, Enthalpy/ Concentration Diagrams**.** | 8 | 12 |
| 3. | **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. | 8 | 15 |
| 4. | **Phase Equilibria**<br>The Gamma / Phi Formulation of VLE, Equilibrium and stability, Liquid-liquid equilibrium, Solid- Liquid Equilibrium, Osmotic Equilibrium and Osmotic pressure | 6 | 5 |

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

- understand state the conditions of equilibrium for multiphase systems.
- understand and apply fugacity to phase equilibria problems.
- compute the vapor pressure for single-component multiphase systems.
- apply partial molar quantities to compute mixture properties.
- apply models for excess Gibbs free energy in non-ideal mixtures.
- construct binary phase diagrams for multiple phase systems correcting for non-ideal behaviour using fugacity coefficients and activity coefficients.
- perform calculations for vapor-liquid equilibrium.
- determine the equilibrium composition for a reacting system given the reaction stoichiometry, temperature and pressure.

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

## Centre for Skill Enhancement & Professional Development

Course Code: SEPD3010
Course Name: Professional Communication & Soft Skills
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 | |
| 01 | 02 | 00 | 02 | 00 | 00 | 50 | 50 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand multifaceted Professional Speaking Process.
- learn the writing etiquettes for professional purposes.
- gain basic knowledge, skills and the right attitude to succeed in future professional working environment.
- develop confidence, enhance their professional communication ability in civilized, harmonized manner.
- sharpen communication skills with reference to organizational structure.
- expose themselves to the modern modes of communication

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Self-Management & Career Building**<br>• Self-Evaluation, discipline and criticism<br>• SWOT analysis to identify personal strength/ weakness<br>• Planning & Goal setting<br>• MBTI test for self-analysis<br>• Profiling on Online Platforms | 01 | 7 |
| 2. | **Interpersonal Organizational Communication**<br>• Interpersonal Behavioral Skills<br>• Understanding empathy and comprehend other's opinions/ points of views, Managing Positive and negative emotions<br>• Healthy and Unhealthy expression of emotions. | 04 | 25 |

| | | | |
|---|---|---|---|
| | • Mutuality, Trust, Emotional Bonding and handling situation in interpersonal relationship | | |
| 3. | **Professional Communication (Speaking) - I**<br>• Professional Communication and Rhetorics<br>• Art of Telephonic Conversation<br>• Public Speaking | 03 | 18 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Professional Communication (Speaking) – II**<br>• Group Discussion (Concept, importance, Methods, Dos and Don'ts, Paralinguistic and Nonverbal Etiquettes)<br>• Personal Interview (Concept, Importance, Methods, Dos and Don'ts, Type, Paralinguistic and Nonverbal Etiquettes) | 03 | 20 |
| 2. | **Professional Communication (Writing)**<br>• Cover Letter and Resume Building<br>• E mail writing<br>• Report Building<br>• Technical/ Academic Writing (Reference/ citation/ plagiarism) | 04 | 30 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | SWOT analysis & Profiling | 04 |
| 2. | MBTI Test | 02 |
| 3. | Interpersonal Organizational Communication | 02 |
| 4. | Group Discussion | 04 |
| 5. | Personal Interview | 04 |
| 6. | Cover Letter and Resume | 06 |
| 7. | E mail and Report Writing | 04 |
| 8. | Technical Academic Writing | 04 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Professional Communication | Sheekha Shukla | 2010, WordPress |
| Professional Communication Skills | Rajesh Kariya | Paradise Publication, Jaipur |
| Soft Skills and Professional Communication | Petes S. J., Francis. | Tata McGraw-Hill Education, 2011 |
| Effective Communication and Soft Skills | Nitin Bhatnagar | Pearson Education India |
| Behavioural Science: Achieving Behavioural Excellence for Success | Dr. Abha Singh | John Wiley & Sons, 2012 |
| The Hard Truth about Soft Skills | Klaus, Peggy, Jane Rohman & Molly Hamaker | London: Harper Collins |

**Course Evaluation:**

**Practical**

- Continuous Evaluation consists of Performance of Practical to be evaluated out of 10 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 25 marks during End Semester Exam.
- Viva/Oral performance of 25 marks during End Semester Exam.

**Course Outcome(s):**

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

- understand the importance self-analysis for career building.
- learn tactics of communication in professional/ organizational ambience.
- master the art of conversation and public speaking.
- expose themselves for placement processes.
- develop writing etiquettes pertaining to placement and organizational context.

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

**Department of Civil Engineering**

Course Code: SECV3910
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 | |
| 00 | 00 | 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

- 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 |
| | **Grand Total:** | **100** |

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

- apply their theoretical knowledge into reality.
- learn to adapt the workplace situations when they will be recruited.
- be prepared for the real world situations in their future.

**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

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

**Department of Chemical Engineering**

Course Code: SECH3052
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 | |
| 04 | 02 | 00 | 05 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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. | 06 | 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. | 06 | 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. | 10 | 20 |
| **Section II** | | | |
| Module | Content | Hours | Weightage in % |
| 1. | **Design of industrial reactors**<br>Optimum reactor size, plug flow/mixed flow reactors in series and parallel, recycle reactor. | 10 | 15 |
| 2. | **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. | 12 | 15 |
| 3. | **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. | 08 | 20 |

**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 |

**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 |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103106116/

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

- apply the concepts of thermodynamics such as heat capacity, latent heat, heat of reaction, heat of combustion, and heat of formation.
- understand kinetics of competing reactions and their influence on product yield and selectivity.
- understand fundamentals of kinetics including definitions of rate and forms of rate expressions and relationships between moles, concentration, extent of reaction and conversion.
- derive batch, CSTR, and PFR performance equations from general material balances.
- performance calculations on isothermal plug, mixed, and batch reactors for a homogeneous and heterogeneous reaction from given rate data or a rate expression.
- develop skills to choose the right reactor among single, multiple, recycle reactors etc.

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

**Department of Chemical Engineering**

Course Code: SECH3062
Course Name: Process Equipment & Design - I
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 | |
| 04 | 04 | 00 | 06 | 40 | 60 | 20 | 30 | 00 | 00 | 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:**

| **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. | 10 | 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 | 10 | 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. | 10 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **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 |
| 2. | **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. | 20 | 25 |

**Drawing of Process Equipment:**

| Sr. No | Process Equipment | Hours |
|---|---|---|
| 1. | Flow sheeting, pressure vessel, and enclosures | 04 |
| 2. | Flanges, nozzles and supports | 08 |
| 3. | Agitated vessel and basket centrifuge | 08 |
| 4. | Gravity thickener | 04 |
| 5. | Cyclone separator | 04 |
| 6. | Heat exchangers | 08 |
| 7. | Evaporators | 04 |
| 8. | Crystallizer | 08 |
| 9. | Distillation and absorber column | 08 |
| 10. | Rotary dryer | 04 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Engineering - Volume 6, 3rd Edn | 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 completion of the course, the student will be able to

- design process equipment and modify the design of existing equipment to new process conditions or new required capacity.
- build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
- create understanding of equipment design.
- review the importance of design concepts in process industry.

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

**Department of Chemical Engineering**

Course Code: SECH3071
Course Name: Chemical Process Technology
Prerequisite Course(s): SECH2030 – Unit Processes in Organic synthesis

**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 | 02 | 00 | 05 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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 Feed Stock, Coal Carbonization and Coke Oven Plant, Gasifiers, Gasification of Coal, Petro coke And Biomass. | 06 | 10 |
| 2. | **Chlor-Alkali Industry**<br>Production of Common Salt, Caustic Soda, Chlorine, Hydrochloric Acid and Soda Ash. | 06 | 10 |
| 3. | **Pulp and Paper Industries**<br>Raw Materials, Pulping Processes, Stock Preparation and Paper Making, Chemical Recovery from Black Liquor. | 06 | 10 |
| 4. | **Pesticides Industries**<br>Processes for Manufacturing of Insecticides, Fungicides and Herbicides. | 04 | 05 |
| 5. | **Polymer and Synthetic Fibre Industries**<br>Introduction to Polymerization, Commodity Polymers, Rayon, Polyester, Polyamide, Acrylic Fibre and Nylons. | 08 | 15 |

| Section II | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **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. | 06 | 10 |
| 2. | **Industrial Gases**<br>Technology Options of Producing Producer Gas, Syn gas, Pyro gas, Nitrogen, Oxygen and Carbon dioxide. | 04 | 10 |
| 3. | **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. | 06 | 10 |
| 4. | **Fermentation Industry**<br>Introduction to Sugar, Fermentation Industry and Manufacture of Alcohol, Ethanol as Biofuel and Chemical Feed Stock. | 04 | 05 |
| 5. | **Cement & Glass Manufacturing Industries**<br>Lime Stone Beneficiation and Manufacturing of Cement, Types of Cement, Manufacturing of Glass, Types of Glass. | 04 | 05 |
| 6. | **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. | 06 | 10 |

**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 CaCl2 from HCl and lime (CaCO3). | 02 |

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

- apply knowledge of science, and engineering.
- design and conduct experiments, as well as to analyze and interpret data.
- run the process to meet desired needs within realistic constraints such as manufacturability, and sustainability.
- understand, identify, formulate and solve engineering problems.

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

**Department of Mechanical Engineering**

Course Code: SEME4021
Course Name: Renewable Energy Systems
Prerequisite Course(s): SEME3011 - Heat Transfer 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 | |
| 03 | 02 | 00 | 04 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- identify which are the different renewable energy sources available and their national scenario.
- interpret Solar energy and related terminology along with their possible applications and conversions.
- understand Wind energy and related terminology along with their conversion to produce electricity.
- explore the geothermal and ocean energy with their possible conversions.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module. No. | Content | Hours | Weightage in % |
| 1. | **Renewable Energy Scenario**<br>Scope for renewable energy, Advantages and Limitations of Renewable Resources, Present Energy Scenario of Conventional and Non-conventional Resources, Government Policies, National Missions. | 04 | 10 |
| 2. | **Solar Energy**<br>Energy Available from the Sun, Spectral Distribution, Sun-Earth angles and their relations, Measuring techniques and Estimation of Solar Radiation Outside and the Earth's Atmosphere, Radiation on tilted surface<br>**Solar Power generation**<br>Photovoltaic system for power generation, Types of solar cell modules and arrays, Solar cell types, Grid Connection, Payback Period Calculation, Advantages and Disadvantages, Site Selection and Other Parameters. | 19 | 40 |

| | | | |
|---|---|---|---|
| | **Solar Applications**<br>Conversion of Solar Energy into Heat, Solar thermal collectors, Solar concentrators analysis and performance evaluation, solar energy thermal storage, Solar based devices like: Solar Pumping, Solar Cooker, Solar still, Solar drier, Solar Refrigeration and Air Conditioning, solar pond, heliostat, solar furnace. | | |
| **Section II** | | | |
| Module. No. | Content | Hours | Weightage in % |
| 1. | **Wind Energy**<br>Principle and basics of wind energy conversion, Energy available from wind, basics of lift and drag, effect of density, angle of attack and wind speed.<br>**Wind Power Conversion**<br>wind turbine rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, Site selection and basics of wind farm, Solar-wind hybrid system. | 09 | 20 |
| 2. | **Bio energy**<br>Energy from biomass, Sources of biomass, different species, conversion process, advantages and disadvantages, Properties of biomass, biomass energy.<br>**Biogas Generation**<br>Conversion of biomass into fuels, gasification and combustion, aerobic and anaerobic bio-conversion, Types of biogas plants, Design and operation, factors affecting biogas generation, gasification, types and applications of gasifiers. | 07 | 15 |
| 3. | **Geothermal energy**<br>Availability, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications.<br>**Ocean Energy**<br>Ocean thermal energy conversion, availability, advantages and limitations; open, closed and hybrid cycle OTEC system, wave and tidal energy, estimation of tidal power, tidal power plants, single and double basin plants, site requirements. | 06 | 15 |

**List of Practical:**

| Sr. No. | Name of Practical | Hours |
|---|---|---|
| 1. | To Prepare one mathematical model using the Sun angles relations for particular any one solar application. | 06 |
| 2. | Demonstration of Solar air heater, solar cooker, Solar pyranometer, Solar collector, biogas plant, gasifier. | 06 |
| 3. | To estimate the solar day time with the help of sunshine recorder. | 02 |
| 4. | To perform efficiency test of solar water heater with its different parameters. | 04 |

| | | |
|---|---|---|
| 5. | To evaluate distilled water output under solar desalination system considering different water depth and day-night performance and calculation of payback period. | 04 |
| 6. | To estimate the solar power generation using PV panel and estimation of Payback period. | 04 |
| 7. | To calculate the wind power generation using the small wind mill. | 04 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Solar Energy-Fundamentals, Design, Modelling and Applications. | G. N. Tiwari | Narosa Publishers |
| Non-conventional energy resources. | Shobh Nath Singh | Pearson India |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Principles of Solar Engineering | F. Kreith and J.F. Kreider | McGraw Hill |
| Solar Energy thermal processes | J.A. Duffie and W.A. Beckman | J. Wiley |
| Wind energy Theory and Practice | Ahmed | PHI, Eastern Economy Edition |
| Renewable Energy Sources and Emerging Technologies | Kothari | PHI, Eastern Economy Edition |

**Web Material Link(s):**

- https://nptel.ac.in/courses/112107216/ (Review of Thermodynamics)
- https://nptel.ac.in/courses/108105058/8 (Thermal Power Plants)
- https://nptel.ac.in/courses/112106133/15 (Capacity of Steam Power Plant)

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

- interpret national energy scenario and its possible utilization to become self-reliant in the field of renewable energy.
- define the availability of bio energy and its utilization in rural as well urban areas to use natural wastes and their conversion in biogas along with power generation.
- identify the types of renewable energies with their eco-friendly applications.

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

**Centre for Skill Enhancement & Professional Development**

Course Code: SEPD 3020
Course Name: Corporate Grooming & Etiquette
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 | |
| 01 | 02 | 00 | 02 | 00 | 00 | 50 | 50 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

**Objective(s) of the Course:**
To help learners to
- learn corporate and professional structure and mannerisms.
- acquire self-development skills to balance casual and formal situation.
- polish their personal skills for apt behavior in the context of corporate structure.
- develop adequate Skill set required for the workplace.
- become aware about the professional etiquettes and tactics to follow them.

**Course Content:**

| **Section – I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Corporate Grooming**<br>• Introduction to corporate culture<br>• Corporate Expectations<br>• Need of Self-Grooming to the Corporate Expectations<br>• Understanding and importance of Professionalism | 03 | 25 |
| 2. | **Personal Skills**<br>• Behavioral skills<br>• Language Skills<br>• Knowledge Skills<br>• Problem Solving Skills<br>• Developing professional attitude | 04 | 25 |
| **Section – II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Management Skills**<br>• Self-management<br>• Time management<br>• Work life balance | 04 | 25 |

| | | | |
|---|---|---|---|
| 2. | **Organizational Etiquettes**<br>• General Workplace Etiquettes<br>• Presentation Etiquettes<br>• Meeting Etiquettes | 04 | 25 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Corporate Grooming (Video session/ Role Play/ Skit) | 04 |
| 2. | Personal Skills (Games/ Quiz/ Activities) | 08 |
| 3. | Management Skills (Management Activities/ Video Sessions) | 06 |
| 4. | Organizational Etiquettes (Case Study/ Activities/ Video Sessions) | 06 |
| 5. | Computer Assisted Activities of Corporate Grooming | 06 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Grooming and Etiquette for Corporate Men and Women | John Chibaya Mbuya | 2009 |
| Effective Communication Skills for Public Relations | Andy Green | Kogan Page, 2006 |
| Personality Development and Soft Skills | Barun Mitra | Oxford University Press, 2016 |
| The EQ Edge: Emotional Intelligence and Your Success | Stein, Steven J. & Howard E. Book | Wiley & Sons, 2006. |
| Cross Cultural Management: Concepts and Cases | Madhavan | Oxford University Press, 2016 |
| Corporate Grooming and Etiquette | Sarvesh Gulati | Rupa Publications India Pvt. Ltd., 2012 |
| Behavioural Science: Achieving Behavioural Excellence for Success | Dr. Abha Singh | John Wiley & Sons, 2012 |

**Course Evaluation:**

**Practical**

- 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 25 marks during End Semester Exam.
- Viva/Oral performance of 25 marks during End Semester Exam.

**Course Outcome(s):**

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

- understand the importance of professional etiquettes and ways to improve the same.
- gain the knowledge and practice of skill sets required in corporate set up.
- learn personal management skills in the organizational context.
- develop an awareness about the corporate etiquettes.

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

**Department of Chemical Engineering**

Course Code: SECH3510
Course Name: Pharma Technology – API and Formulation
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 - Active Pharmaceutical Ingredients – API** | | | |
|---|---|---|---|
| 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, 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 Strategies, Powder Processing Area (PPA) – | 10 | 25 |

| | | | |
|---|---|---|---|
| | Conditions, Validation and Cleaning processes. | | |
| **Section II – Formulations** | | | |
| Module No.. | Content | Hours | Weightage in % |
| 1. | **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 |
| 2. | **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 |
| 3. | **Semisolids Formulation**<br>Semisolid Formulation with Special Reference to Penetration Enhancers, Emulgels, Semisolids based on Liposomes, Niosomes. | 04 | 10 |
| 4. | **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 |

**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

- understand basic unit processes and unit operations involved in pharma industry.
- understand the role of individual in the chemical pharmaceuticals.
- relate the different equipment with usage and applications.
- differentiate API and Formulation in the pharmaceutical industries.
- apply knowledge of basic science in dosage and Formulation to enhance the plant efficiency.

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

**Department of Chemical Engineering**

Course Code: SECH3520
Course Name: Process Auxiliaries and Utilities in Allied 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 – Process Auxiliaries in Allied Industries** | | | |
|---|---|---|---|
| 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 | 5 | 15 |

| | | | |
|---|---|---|---|
| | Instrumentation Diagram, Control System Design for Process Auxiliaries. | | |
| **Section II – Process Utilities in Allied Industries** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **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 |
| 2. | **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 |
| 3. | **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 |
| 4. | **Refrigeration System**<br>Refrigeration and Chilling Systems, Oil Heating Systems, Nitrogen Systems. | 02 | 5 |

**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

- learn about the overall knowledge about the process plant.
- understand the importance of process auxiliaries and utilities in process industries.
- learn the conceptual design of chemical process plant.
- build a bridge between theoretical and practical concepts used for process auxiliaries and utilities in any process industry.

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

**Department of Chemical Engineering**

Course Code: SECH3530
Course Name: Air Pollution & 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 | 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 various effects of air pollution.
- impart the knowledge on air pollution.
- analyze causes and effects of air pollution.
- familiarize with strategic planning for control of air pollution.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Air Pollution**<br>Definition of Air Pollution - Sources and Classification of Air Pollutants-Effects of Air Pollution-Global Effects-Air Quality Emission Standards-Sampling of Pollutants in Ambient Air-Stack Sampling. | 6 | 15 |
| 2. | **Meteorology and Air Pollution**<br>Factors influencing Air Pollution, Wind Rose, Mixing Depths, Lapse Rates and Dispersion, Atmospheric Stability, Plume rise and Dispersion, Prediction of Air Quality, Box Model, Gaussian model, Dispersion Coefficient, Application of Tall Chimney for Pollutant Dispersion. | 6 | 15 |
| 3. | **Control of Particulate Pollutants**<br>Properties of Particulate Pollution, Particle Size Distribution, Control Mechanism, Dust Removal Equipment, Design and Operation of Settling Chambers, Cyclones, Wet Dust Rubbers, Fabric Filters and ESP. | 6 | 10 |
| 4. | **Control of Gaseous Pollutant**<br>Process and Equipment for the Removal of Gaseous Pollutants by Chemical Methods – Design and Operation of Absorption and Adsorption Equipment, Combustion and Condensation equipment. | 5 | 10 |

| Section II | | | |
|---|---|---|---|
| Module | Content | Hours | Weightage in % |
| 1. | **Control Of Air Pollution**<br>Zoning and Site Selection-Other Management Controls, API Legislation, Automobile Pollution and Control-Emission Standards. | 7 | 15 |
| 2. | **Urban Air Pollution**<br>Sectoral Analysis, Trends in Major Cities of India and Government initiatives. | 4 | 10 |
| 3. | **Introduction to indoor air pollution** | 4 | 10 |
| 4. | **Global effects of air pollution**<br>Green House Effects, Acid Rain and Ozone Layer Depletion, International Agreements for Mitigating Global Air Pollution Effects. | 7 | 15 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Air pollution | Wark and Warner | Harper & Row, New York. |
| Air Pollution | M.N.Rao and H.V.N.Rao | McGraw Hill Education |
| Air pollution | Prof. K.V.S.G. Muralikrishna | Kaushal Publications – Kakinada |

**Reference Book(s):**

| | | |
|---|---|---|
| An introduction to Air Pollution | R.K. Trivedy and P.K. Goel | B.S. Publications |

**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

- understand the Sources of Air pollutants and its classification.
- demonstrate the ability to design and operation of control units.

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

## Department of Chemical Engineering

Course Code: SECH3540
Course Name: Polymer Science & 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 | 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

- get knowledge of polymers, polymerization techniques and behavior in polymers.
- explore various types of thermoplastics, thermosetting and elastomers.
- Familiarize with various polymer processing techniques for polymers, rubbers and fibers.
- get knowledge on various testing methods and characterization of polymers.
- get knowledge on specialty polymers.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Polymers**<br>Polymers, Polymerization, History of polymers, Pioneers in Polymer Science, Chemistry of Polymerization –Addition, Condensation, Coordination Polymerization –Mechanism and Kinetics, Degree of Polymerization, Polymerization Conditions (Bulk, Solution, Precipitation, Suspension, Emulsion, Interfacial), Crystallinity– Polymer Single Crystals, Spherulite Sand Glass Transition Temperature(tg). | 07 | 15 |
| 2. | **Thermoplastics, Thermosetting and Elastomers**<br>Thermoplastic Polymers – Poly-Olefins – Vinyl Polymers – Polystyrene, PMMA - Pan, Thermoplastic Polymers – Teflon – Polyamides – Polycarbonates and their Applications, Thermosetting Polymers – Phenolic Resins –Polyesters – Epoxies – Polyurethanes and their Applications, Elastomers- Natural rubber – Isoprene Rubber, Synthetic Rubbers - Butadiene Rubber- Butyl Rubber- Styrene Butadiene Rubber, Chloroprene Rubber- Nitrile Rubber - Silicone Rubber. | 10 | 25 |

| | | | |
|---|---|---|---|
| 3. | **Polymer Processing**<br>Processing of Thermoplastics and Thermosetting plastics – Compounding and Processing Aids, Compression Moulding - Injection Moulding – Extrusion Moulding, Blow Moulding, Rotational Moulding, Transfer Moulding, Processing of Rubbers – Vulcanization, Mastication – Calendaring, Reaction Injection Moulding – Solution Casting – SMC and DMC, Fiber Spinning and Drawing. | 06 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Testing & Characterization of Polymers**<br>Polymer Characterization Tests - Melt Flow Index, Capillary Rheometer Test, Viscosity Test, GPC, Thermal Analysis Techniques – DSC, TGA and TMA, Morphology - SEM, TEM, XRD, Mechanical Properties- Tensile Test, Impact Test, Hardness, Electrical properties –Di-Electric Strength & Di-Electric Constant, Thermal Properties-HDT, Vicat. | 12 | 30 |
| 2. | **Specialty Polymers**<br>Poly-Electrolytes and Ionomers, Conducting Polymers – Electro-Luminescent Polymers, High temperature Polymers and Polymer Blends, Polymer Composites and Nano-Composites, Interpenetrating Polymer Networks, Liquid Crystalline Polymers, Biomedical Polymers. | 10 | 20 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Polymer Science | V R Gowariker, Vasant R. Gowariker, N V Viswanathan, JayadevSreedhar | New Age International, 2nd Edition |
| Polymer Science and Technology | Joel R.Fried | PHI, Eastern Economy Edition, 2nd Edition |

**Reference Book(s):**

| | | |
|---|---|---|
| Text book of Polymer Science | Billmeyer F. W. | 3rd edn., Wiley, Singapore, 1984 |
| Speciality Polymers | R.W. Dyson | Chapman and Hall, New York, 1987 |
| Handbook of Plastics Testing Technology | Vishu Shah | Wiley international publication |

**Web Material Link(s):**

- https://nptel.ac.in/courses/113105028/

**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

- elaborate on step-growth and chain polymerization with respect to mechanism and kinetics.
- elaborate on the differences between crystalline melting temperature and glass transition temperature, as well as the effect of kinetics on both.
- distinguish between absolute and relative methods for molecular weight determination.
- describe the flow properties of polymer melts and solutions.
- interpret experimental data and determine parameters such as polymerization rates and copolymer composition.
- estimate the solubility of a given polymer in various solvents and blends.

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

**Department of Chemical Engineering**

Course Code: SECH3550
Course Name: Computational Methods in Chemical Engineering (MATLAB 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 | |
| 2 | 2 | 0 | 3 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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 % |
| 1. | **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 |
| 2. | **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 |

**List of Practical:**

| Sr. No | List of Experiments | Hours |
|---|---|---|
| 1. | Introduction to MATLAB | 02 |
| 2. | Plotting with MATLAB | 02 |
| 3. | Scripts & functions | 02 |
| 4. | Matrix generation | 02 |
| 5. | MATLAB programming and debugging | 02 |
| 6. | Array Operations | 04 |
| 7. | Solving linear equations | 04 |
| 8. | M-file scripts | 02 |
| 9. | M-file functions and input to script file | 02 |
| 10. | The "if...end" structure | 02 |
| 11. | The "for...end" loop | 02 |
| 12. | The "while...end" loop | 02 |
| 13. | Relational and logical operators | 02 |

**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 | Nirali Prakashan |
| 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:**

**Practical**

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

- perform an error analysis for a given numerical method.
- solve a linear system of equations and non-linear algebraic or transcendental equation using an appropriate numerical method.
- approximate a function using an appropriate numerical method.
- understand the basics of MATLAB and implement it in solving complex chemical engineering problems.

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

**Department of Chemical Engineering**

Course Code: SECH3560
Course Name: Environmental issues, Waste Management & EIA
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**<br>Principles of Environmental Management, Ecosystem concept, Environmental concerns in India, Policy and Legal Aspects of EM. | 05 | 10 |
| 2. | **Environmental Policies**<br>Introduction to Environmental policies**,** Environmental Laws and Legislations, Environmental Legislation in India. | 06 | 10 |
| 3. | **Environmental Impact Assessment (EIA)**<br>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**<br>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 % |
| 1. | **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 |
| 2. | **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 |
| 3. | **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 |
| 4. | **Environmental Economics**<br>Environmental Economics, Economics and the Environment, Environmental Valuation, Economics of Natural Resource, Environmental and Regional Economics, Ecological Economics. | 07 | 10 |

**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

- understand environmental management approaches in India and internationally.
- analyses environmental management in relation to the major principles of sustainable development.
- translate generic concepts and methods into critical reviews of contemporary, real-world environmental management practices.
- critically assess theoretical and conceptual issues relating to environmental management utilizing dialectical analysis approaches.
- present synthesized and critically evaluated information in oral and written forms.
- work effectively to create environmental management analysis outputs of professional quality, both independently and within team environments.

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

**Department of Chemical Engineering**

Course Code: SECH3570
Course Name: Fundamentals to Dyes and Pigment
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

- study the New Functional dyes & Recent Trends in Dyes Technology in chemical industries.
- provides fundamental knowledge of new functional Dyes which is applicable in chemical industries.
- study the basic Technology applied in various types of pigments in chemical industries.
- provides fundamental knowledge of various types of pigments and how to carry out manufacturing & applications of these pigments in chemical industries.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Technology of Fibers**<br>Classification of coloring matters according to their application to the fibers, Physical and chemical structures of fibers and dyes in relation to dyeing, Interaction between dye molecules and the fibers, dyeing of different dyestuffs onto various natural textile fibers, Dye-fiber bonds and parameters affecting them. | 05 | 10 |
| 2. | **Physicochemical Properties of Dye-Fiber Systems**<br>Thermodynamics and Kinetics of dyeing process, Affinity of dyes towards the fibers, Adsorption isotherms, Equilibrium adsorption and factors influencing the same, Saturation value, Diffusion coefficient, Glass transition temperature and its effect on dyeability, Electro-kinetic properties of dye-fiber systems. | 08 | 15 |
| 3. | **New Techniques in Dyeing**<br>Compatibility of dyes in mixtures, Dyeing of fiber blends and shade matching, Important properties of dyestuffs and their evaluation, Evaluation of fastness properties of dyed materials | 05 | 15 |

| | | | |
|---|---|---|---|
| | and their acceptability limits, Novel dyeing techniques. | | |
| 4. | **Method of Dyeing & Dyeing Machineries**<br>Batch type, semi continuous and continuous type dyeing machinery for all forms of fibers. | 04 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Pigments**<br>Definitions of pigment, extenders, dyes, pigment dyestuffs, toner and lakes, Classification of inorganic and organic pigments with examples, Additive and Subtractive colour mixing. | 05 | 10 |
| 2. | **General Methods of Processing and Synthesis of Organic and Inorganic Pigments**<br>Crushing and Grinding, Vaporization, Co Precipitation, Filtration, Drying, Flushing, Calcinations/Roasting, Vapor phase oxidation etc., A brief study of coal tar distillation and the role of distillation products in the manufacture of synthetic dyes: bases and precipitants used in the color striking, toners and lake formation. | 06 | 15 |
| 3. | **Extenders or Filler Pigments**<br>Sources, manufacture, properties and uses of carbonates, sulphates and other extender pigments like Calcium carbonate, hydrated aluminum oxide, aluminum silicates/ china clays, Magnesium silicate/ talc. | 06 | 15 |
| 4. | **Manufacture, Properties and Applications of Black, Blue and Green Pigments**<br>Channel blacks, Furnace blacks, Lampblacks, Acetylene blacks, Graphite, black iron oxide, Jet ness of black, Chrome green, pigment green B, Ultramarine blue, Prussian blue, Phthalocyanines: Copper phthalocyanines, phthalocyanine green. | 06 | 10 |

**Text Book(s):**

| **Title** | **Author/s** | **Publication** |
|---|---|---|
| Handbook of Synthetic Dyes and Pigments | K. M. Shah | Multitech Publishing Company, Bombay |
| Technology of Dyeing | Shenai V.A | Sevak Publication, Bombay |
| A manual of Dyeing : For use of Practical Dyers, Manufactures, Students and all interested in art of dyeing | E.Knecht, C. Rawson, R.Loewenthal | Charles Griffin and Company Ltd., London |
| Industrial Inorganic Pigments | G. Buxbaum (Ed.) | Completely Revised Edition, 1998, ISBN 3-527-28878-3 |

**Reference Book(s):**

| | | |
|---|---|---|
| Dyeing and Printing | Cockett S.R., Hilton K.A. | Leonard Hill Books Ltd., London |
| Encyclopedia of Textile Finishing | Rouette Hans-Karl | Springer-Verlag, Berlin |

**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

- get an introductory knowledge of Pigments Technology and classification, types & manufacturing of pigments.
- apply this knowledge in Pigments industries.
- build a bridge between theoretical and practical concept used in industry.
- get an introductory knowledge of New Functional dyes & Recent Trends in Dyes Technology.
- apply this knowledge in Dyes industries.

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

**Department of Chemical Engineering**

Course Code: SECH3580
Course Name: Processing in Agrochemical, Food Industries & Biochemical 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 various synthesis process of pesticides and insecticides.
- understand the important processes in food industry.
- develop understanding about biochemistry and bio chemical processes.
- develop understanding about application of engineering principles in biochemical.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content – Agrochemical and Food industries | Hours | Weightage in % |
| 1. | **Pesticides and Insecticides Synthesis**<br>History of pesticides and insecticides, Development of Pesticides and insecticides, Brief introduction to classes of pesticides and insecticides (Chemical class, targets), structures, chemical names, physical and chemical properties, synthesis, degradation, metabolism, formulations, mode of action, uses, toxicity (acute and chronic toxicity in mammals, birds, aquatic species etc.), methods of analysis. | 06 | 10 |
| 2. | **Important Parameters of Pesticides Formulations Affecting Quality of Pesticides –**<br>particle size, bulk density, flowability, electrostatic charge, sorptivity, compatibility, and their effects on stability, rainfastness and shelf life of formulation, Rheological properties | 03 | 10 |
| 3. | **Tests for Quality Control**<br>A brief introduction on Specifications of Pesticide technical and formulations (WHO/FAO/BIS) Methods of analysis of Physical properties of formulations- Suspensibility, Wettability, Emulsion stability, wet sieve test, acidity, alkalinity, moisture content, Flash Point, Specific gravity, Persistent foaming, water runoff test, dry sieve test etc. and their significance during field application. | 05 | 10 |

| | | | |
|---|---|---|---|
| 4. | **Introduction to Food industries**<br>General aspects of food industry, world food demand and Indian scenario, constituents of food, quality and nutritive aspects, Food additives, standards, deteriorative factors and their control, preliminary processing methods, conversion and preservation operation. | 04 | 10 |
| 5. | **Energy Engineering, Process calculation and Packaging**<br>Fuel Utilization, Process Controls in Food Processing, Systems for Heating and Cooling Food Products, Thermal Properties of Foods, Preservation by heat and cold dehydration, concentration, frying, irradiation, microwave heating, sterilization and pasteurization, treatment and disposal of food processing wastes, Food Protection, Product Containment, Innovations in Food Packaging, Food Packaging and Product Shelf-life. | 05 | 10 |
| **Section II** | | | |
| Module No. | Content – Biochemical Engineering | Hours | Weightage in % |
| 1. | **Introduction to Biochemical Engineering**<br>History, Background, Interdisciplinary approach, Integrated bioprocess, Unit operations in bioprocess. | 01 | 02 |
| 2. | **Microbial Growth Kinetics**<br>Cell growth in Batch Culture, Continuous culture – multistage system, Phases of cell growth in batch cultures, Monod model, Factors affecting microbial growth, Maintenance energy, environmental factors affecting microbial growth, heat generation by microbial growth, Cell growth and product formation, Elemental balances, Degrees of reduction of substrate and biomass available, electron balances, Yield coefficient of biomass and product formation, Maintenance coefficients, Energetic analysis of microbial growth and product formation, oxygen consumption | 08 | 18 |
| 3. | **Enzyme kinetics:**<br>Enzyme and its Classification, Mechanisms of enzyme action–concept of active site, Estimation of Michelis-Menten parameters, Inhibiter–types of inhibition mechanism, Enzyme Immobilization – types, Enzyme deactivation: mechanisms and manifestations of protein denaturation, Deactivation models and kinetics, Enzyme used in current and developing industry | 07 | 15 |
| 4. | **Bioreactors**<br>Basic principle of Bioreactor, Design and Operation of Biochemical reactors - Fluidized bed, Regime analysis of Biochemical reactors processes, Correlations for oxygen transfer, Scale-up criteria for bioreactors based on oxygen transfer and power consumption, Measurement of physical and chemical parameters in bioreactors, Separation, isolation and purification of Biomolecule. | 06 | 15 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Pesticide Synthesis Handbook | Thomas A. Unger | Prochrom Industrias Quimicas S/A Elsevier, 1996. |
| Chemistry of Insecticides and Fungicides | U. S. Shree Ramulu | Oxford & IBH Pub., 2nd, 1995 |
| Biochemical Engineering Fundamentals | J. E. Bailey and D. F. Ollis | McGraw Hill, New York, 1986. |
| Biochemical Engineering | H. W. Blanch and D. S. Clark | Marcel Dekker, Inc., New York, 1996. |

**Reference Book(s):**

| | | |
|---|---|---|
| The Agrochemical Handbook | Hartley, D., Kidd, H | Royal Society, England, 1984. |
| Biochemical Reaction Engineering in Chemical Engineering, Vol. III, 3rd Edn. | R.Lovitt and M.Jones Edited by J. F. Richardson and Peacock | Pergamon, London, 1994. |

**Web Material Link(s):**

- http://nptel.ac.in/courses/103105054/

**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

- conceive, design, and operate food processes, equipment, and plants for efficient food production with minimal impact on the environment.
- learn to apply engineering principles and concepts to handling, storing, processing, packaging, and distributing food and related products.
- provide an understanding of the chemical, biochemical, microbiological, and physical characteristics of foods.
- analyses the kinetics of cell growth and product formation in area of bio chemical.
- understand models of bioprocesses and design downstream processes involved in product recovery.

# FOURTH YEAR B. TECH.

| P P SAVANI UNIVERSITY | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCHOOL OF ENGINEERING | | | | | | | | | | | | | | | | |
| TEACHING & EXAMINATION SCHEME FOR B. TECH. CHEMICAL PROGRAMME AY:2018-19 | | | | | | | | | | | | | | | | |
| **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 | SECH4011 | Process Equipment & Design-II | CH | 4 | 4 | 0 | 8 | 6 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH4021 | Chemical Reaction Kinetics - II | CH | 4 | 2 | 0 | 6 | 5 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH4030 | Petroleum Studies | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH4050 | Modelling, Simulation & CAD in Chemical Engineering | CH | 3 | 2 | 0 | 5 | 4 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SEPD4010 | Creativity, Problem Solving & Innovation | SEPD | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH4910 | Industrial Training /Project | CH | 4 | | | 0 | 4 | 0 | 0 | 100 | 100 | 0 | 0 | 200 |
| | | **Elective -III** | CH | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | | | | | | **Total** | **30** | **29** | | | | | | | **1000** |
| 8 | SECH4062 | Transport Phenomena | CH | 4 | 0 | 1 | 5 | 5 | 40 | 60 | 0 | 0 | 50 | 0 | 150 |
| | SECH4070 | Process Integration & Process Optimization | CH | 4 | 2 | 0 | 6 | 5 | 40 | 60 | 20 | 30 | 0 | 0 | 150 |
| | SECH4041 | Chemical Engineering Plant design, Economics & Industrial Management | CH | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 0 | 0 | 0 | 0 | 100 |
| | SECH4920 | Project based learning | CH | 8 | | | 8 | 8 | 0 | 0 | 100 | 150 | 0 | 0 | 250 |
| | | | | | | **Total** | **21** | **20** | | | | | | | **650** |

| P P SAVANI UNIVERSITY | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCHOOL OF ENGINEERING | | | | | | | | | | | | | | | | |
| TEACHING & EXAMINATION SCHEME FOR FOURTH YEAR B.TECH. CHEMICAL ENGINEERING PROGRAMME (ELECTIVE COURSES) | | | | | | | | | | | | | | | | |
| **Sem** | **Course Code** | **Department Elective 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 | SECH4510 | Chemical System Modelling | CH | 03 | 00 | 00 | 03 | 03 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |
| | SECH4520 | Quality Control & Quality Assurance – Instrumentation & Validation Process | CH | 03 | 00 | 00 | 03 | 03 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |
| | SECH4530 | Membrane Technology | CH | 03 | 00 | 00 | 03 | 03 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |
| | SECH4540 | Industrial Health & Safety Engineering | CH | 03 | 00 | 00 | 03 | 03 | 40 | 60 | 00 | 00 | 00 | 00 | 100 |

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

## Department of Chemical Engineering

Course Code: SECH4011
Course Name: Process Equipment & Design-II
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 | |
| 04 | 04 | 00 | 06 | 40 | 60 | 20 | 30 | 00 | 00 | 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:**

| **Section I** | | | |
|---|---|---|---|
| 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 (IS, ASTM and BS). | 02 | 05 |
| 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 When Handling Viscous Liquids, Power Required in Fan, Blower and Adiabatic Compressor, Flow Meters, Process Design of Orifice Meter, Rotameter Etc. | 13 | 20 |
| 3. | **Process Design of Extractor**<br>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 | 15 | 25 |

| Section II | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Mechanical design of Reaction Vessel**<br>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, Determination of Power Required for Agitation, Shaft Diameter, Blade Thickness, Etc. | 12 | 20 |
| 2. | **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 | 10 | 18 |
| 3. | **Supports**<br>Different Types of Supports, Mechanical Design of Bracket Support, Skirt, Support & Saddle Support, Numerical | 08 | 12 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Flow sheeting of piping | 04 |
| 2. | Flow sheeting of pumps | 04 |
| 3. | Flow sheeting of compressor | 04 |
| 4. | Flow sheeting of flow meters | 04 |
| 5. | Flow sheeting of extractor | 08 |
| 6. | Flow sheeting of agitated vessel | 04 |
| 7. | Flow sheeting of different types of agitator | 08 |
| 8. | Flow sheeting of different types of extractors | 08 |
| 9. | Flow sheeting of storage tank | 04 |
| 10. | Flow sheeting of bracket support | 04 |
| 11. | Flow sheeting of skirt support | 04 |
| 12. | Flow sheeting of saddle support | 04 |

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

- design process equipment and modify the design of existing equipment to new process conditions or new required capacity.
- build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
- create understanding of equipment design.
- review the importance of design concepts in process industry.

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

## Department of Chemical Engineering

Course Code: SECH4021
Course Name: Chemical Reaction kinetics - II
Prerequisite Course(s): SECH3052 - 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 | |
| 04 | 02 | 00 | 05 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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 and design 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:**

| **Section I** | | | |
|---|---|---|---|
| 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, Dispersion model, Chemical Reaction and dispersion, Intensity of fluid mixing. Tanks in series model, Deviation from plug flow, Models for real stirred tanks. | 09 | 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. | 07 | 10 |
| 3. | **Fluid-Fluid Systems**<br>Rate equation, rate equation for straight mass transfer, kinetic regimes of mass transfer and chemical reaction, rate equation for mass transfer and chemical reactions, film conversion parameter, fluid-fluid reactor design. | 08 | 15 |

| | | | |
|---|---|---|---|
| 4. | **Fluid-Particle Systems**<br>Fluid partial reaction kinetics, selection of a model, Shrinking Core Model for unchanging and changing size spherical partials, Diffusion through gas film and through ash layer controlling, Chemical reaction controlling, shrinking core model, its limitations, Determination of rate controlling step. | 06 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Catalysis**<br>Catalysts, Physical properties of catalyst, surface area, void volume, solid density, pore volume distribution, Classification and preparation of catalyst, catalyst promoters. Catalyst inhibitors, Catalyst poisons, Nature and Mechanism of Catalytic reactions. | 12 | 20 |
| 2. | **Solid-Catalysed Reactions: Kinetics**<br>Adsorption isotherms and rates of adsorption and desorption. Kinetic regimes, rate equations for surface kinetics, Pore diffusion, determining rate controlling step, experimental methods for finding rates, product distribution in multiple reactions. | 08 | 15 |
| 3. | **Introduction to Catalytic Reactor**<br>Packed bed catalytic reactors, fluidized bed reactors, trickle beds, slurry reactors. Kinetics of Bio-Reaction, Monod Equation, Design of Bioreactors, Reactions in Solids – Reactors for Solid Reactions, CVD Reactors, Monolithic Reactors, Gauze Reactors | 10 | 15 |

**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 |

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

- analyze the RTD studies for any flow reactor, to predict the deviation from ideal reactors by evaluating the dispersion number.
- analyze the various contacting pattern for two phase system and predict the rate equation for heterogeneous reactions.
- analyze the best kinetic regimes for mass transfer and reaction for a given reaction and
- predict the rate equation.
- predict the rate controlling step for the fluid - particle reactions.
- classify catalysts and predict physical properties of catalyst, surface area, void volume, solid density pore volume distribution.
- understand the nature and mechanism of catalytic reactions.

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**School of Engineering**

## Department of Chemical Engineering

Course Code: SECH4030
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 | 00 | 04 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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 , 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 etc. | 06 | 10 |
| 3. | **Processing of Petroleum** | 04 | 10 |

| | | | |
|---|---|---|---|
| | Pretreatment of Crude (Dehydration & Desalting), Pumping of Waxy Crude, Heating of Crude, Distillation of Petroleum & Types of Reflux, ADU & VDU, Topping Operations etc. | | |
| 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 etc. | 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 % |
| 1. | **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 |
| 2. | **C1 Petrochemicals**<br>Petrochemicals Obtained from Methanol, Formaldehyde, Chloromethane etc. | 04 | 10 |
| 3. | **C2 Petrochemicals**<br>Petrochemicals obtained from Ethylene, Ethanolamine, Ethylene Dichloride, Vinyl Chloride, Ethylene Oxide etc. | 05 | 10 |
| 4. | **C3 &Aromatic Petrochemicals**<br>Petrochemicals Obtained from Propylene, ACN, Isopropanol, Cunene, BTX Separation, Phenol, Styrene, Phthalic Anhydride etc. | 04 | 10 |
| 5. | **Polymers**<br>PVC, LDPE, LLDPE, HDPE, Polypropylene, Polypropylene Co-polymers, Polystyrene, SBR, Polyesters etc. | 04 | 10 |

**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 |

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

- understand fundamentals of petroleum refinery & various petrochemical plants.

- characterize & test various properties of different petroleum fractions.
- understand scenario of refinery & petrochemical industries.
- understand manufacturing processes & applications of widely used petrochemicals.

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

Course Code: SECH4050
Course Name: Modelling, Simulation & CAD in Chemical 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 | 02 | 00 | 04 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

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:**

| **Section I** | | | |
|---|---|---|---|
| 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 | 06 | 10 |
| 2. | **Introduction to Simulation Tools** | 04 | 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 | 10 | 17 |
| 4. | **Models of Heat Transfer Equipment** Development of Detailed Mathematical Models of Evaporators, Use of Newton Raphson Method for Solving Evaporator Problems | 10 | 15 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **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 | 20 | 25 |

| | | | |
|---|---|---|---|
| | 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 | | |
| 2. | **Models of Reactors**<br>Classification of Fixed Bed Reactor Models, One Dimensional and Two-Dimensional Fixed Bed Reactor Models, Fluidized Bed Reactor Models, Bioreactor Models | 10 | 25 |

**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 |

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

- learn basic definitions and fundamental principles related to process modelling and simulation.
- understand different types of models and their hierarchy as well as the general steps followed in developing a process model.
- develop appropriate mathematical models of varying complexities for different chemical engineering systems.
- know and learn about the commonly available mathematical tools and techniques as used in the simulation of developed models.

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**Center for Skill Enhancement and Professional Development**

Course Code: SEPD4010
Course Name: Creativity, Problem Solving & Innovation
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 | 100 | 00 | 00 | 00 | 00 | 00 | 100 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- achieve expertise with the technicalities of creativity and problem solving.
- advance an assertiveness for innovation.
- advance creative thinking skills using shaft of learning components leading to understanding of plans of creativity, problem solving and innovation
- discuss uses of the concepts of creativity and problem-solving skills in personal, social, academic, and profession life.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Creativity, Problem Solving and Innovation**<br>• Definitions of Problem Solving, Creativity and Innovation<br>• Need for Problem Solving and Innovation & Scope of Creativity<br>• Types and Styles of Thinking<br>• Strategies to Develop Creativity, Problem Solving and Innovation Skills | 08 | 17 |
| 2. | **Questioning and Learning**<br>• Introduction to Questioning, Learning and Visualization and its Strategies<br>• Sources and Methods of Questioning and Learning<br>• Finding Perspective, Visualizing thinking<br>• Mind Mapping | 07 | 16 |
| 3. | **Creative Thinking and Problem Solving**<br>• Need of Creative Thinking | 08 | 17 |

| | | | |
|---|---|---|---|
| | • Cracking Creativity - Reversals, Reversing Perspective, seeing all sides, Looking in other world,<br>• Finding what you are not looking for and following up<br>• Fishbone Diagram<br>• SCAMPER Technique | | |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Logic and Reasoning**<br>• Basic Concept of Logic<br>• Divergent Vs Convergent Thinking, Inductive Vs Deductive Thinking<br>• Fusion of Ideas for Problem Solving<br>• Moral Reasoning<br>• Improvisation | 08 | 17 |
| 2. | **Practices of Playing**<br>• Collaboration and Brainstorming<br>• The Spirit of Koinonia<br>• QFT Model<br>• Connecting the Unconnected<br>• Making Novel Combinations | 07 | 16 |
| 3. | **Review Strategies for Creative problem-solving methods**<br>• A Heuristic Technique<br>• Problem-Solving Strategies: Why Bother?<br>• Five Building Blocks as per Fogler & LeBlanc<br>• Strategy for Critical Thinking for Choosing<br>• Lateral Thinking<br>• Six Thinking Hats by Edward De Bono<br>• Design Thinking | 07 | 17 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Thinker Toys | Michael Michalko | Random House Publication 2006 |
| Crackling Creativity, The Secrets of Creative Genus | Michael Michalko | Ten Speed Press 2001 |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Zig Zag, The Surprising Path to Greater Creativity | R Keith Sawyer | Jossy-Bass Publication 2013 |
| De Bono's Thinking Course | Edward De Bono | Penguin Publication 1994 |
| Six Thinking Hats | Edward De Bono | Penguin Publication 1999 |
| How to Mind Map | Tony Buzan | Thorsons Publication 2002 |
| The Myths of Innovation | Scott Berkum | Berkun Publication 2010 |
| Creative confidence: Unleashing | Tom Kelly and David | William Collins Publication |

| | | |
|---|---|---|
| the creative Potential within Us all | Kelly | 2013 |
| The all Laughed | Ira Flatow | Harper Publication 1992 |
| The Ultimate Lateral & Critical Thinking Puzzle book | Paul Sloane, Des MacHale & M.A. DiSpezio | Sterling Publication 2002 |

**Course Evaluation:**

| Section | Module No. | Evaluation Criteria | Marks |
|---|---|---|---|
| 1 | 1 | Group Activity on Brainstorming | 15 |
| | 2 | Mind Mapping Activity | 10 |
| | 3 | Chart Preparation on 'Practicality of Fishbone Diagram' | 15 |
| | | Group presentation on 'SCAMPER Technique & its applications' | 10 |
| 2 | 1 | Group Presentation on Critical Analysis of a Govt. scheme/ policy/ budget (merit/ demerit, pros/cons etc) | 15 |
| | 2 | Group Discussion/ Debate/ Elocution | 10 |
| | 3 | Problem Solving Activity (Individual) | 10 |
| | | Presentation (Learning Outcomes) | 15 |
| | | **Grand Total** | **100** |

**Course Outcome(s):**

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

- establish creativity in their day-to-day actions and educational output.
- solve all types of problems with an optimistic and an impartial attitude.
- reflect innovatively and work towards problem solving in a tactical way.
- initiate different and advanced practices in their selected field of profession.

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## Department of Chemical Engineering

Course Code: SECH4062
Course Name: Transport Phenomena
Prerequisite Course(s): SECH3010- Heat Transfer Operations
SECH2050- 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 | |
| 04 | 00 | 01 | 05 | 40 | 60 | 00 | 00 | 50 | 00 | 150 |

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:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Analogies in Momentum, Heat and Mass Transfer**<br>Introduction, Reynolds Analogy, Prandtl Taylor Analogy, Van Karman Analogy, Martinelli Analogy, Chilton Analogy | 08 | 15 |
| 2. | **Principles of Momentum & Overall Balances**<br>Newtonian and Non-Newtonian Fluid Models, Classification of Fluids on the Basis of Rheology, General Molecular Transport Equation for Momentum Transfer, Review of Shell Balance Method and Equations of Changes for Fluid Flow Problems, Time Derivatives | 12 | 20 |
| 3. | Equations of Changes for Isothermal, Non-Isothermal, and Multi Component Mixtures. Velocity, Temperature, and Concentration Distributions with more than one Independent Variable; Boundary Layer Theory | 10 | 15 |

| Section II | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Turbulent transport**<br>Laminar-turbulent transition; Basic characteristic features of turbulent flow; Time smoothed equation of changes; Eddy viscosity, thermal conductivity and diffusivity; Distribution of velocity, temperature, and concentration in turbulent flows. | 08 | 10 |
| 2. | **Principles of Heat Transfer**<br>Application of Shell balance and Equations of changes for temperature distributions in heat flow problems Heat conduction with various heat sources, Heat conduction with cooling fins, Temperature distribution for fully developed viscous flow, Heat transfer for non-Newtonian fluids, Unsteady state heat transfer in various geometries, Partial freezing model, Chilling & Freezing of biological materials, Heat transfer with phase change. | 10 | 20 |
| 3. | **Principles of Mass Transfer**<br>Application of Shell balance method and Equations of changes 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. | 12 | 20 0 |

**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

- setup overall balances for conservation of momentum, energy and mass.
- recognize and apply analogies among momentum, heat and mass transfer.
- reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration.
- utilize information obtained from solutions of the balance equations to obtain engineering quantities of interest.
- reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass.

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## Department of Chemical Engineering

Course Code: SECH4070
Course Name: Process Integration & Process Optimization
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 | 02 | 00 | 05 | 40 | 60 | 20 | 30 | 00 | 00 | 150 |

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand the fundamental principles and practical methodologies of process integration;
- impart background knowledge for employment in the process industries as well as for post graduate studies and research;
- formulate simple optimization problem, writing objective functions, equality and inequality constraints and bounds;
- understand simple constrained and unconstrained optimization problem, formulate and solve simple linear programming problems, non-linear programming problems and appreciate the application of optimization in chemical process engineering.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to process integration**<br>Role of thermodynamics in process integration, Concept of pinch technology and its application | 04 | 8 |
| 2. | **Heat Exchange Networks**<br>HENS, Composite curves, Problem table algorithm, Targeting of energy, area, number of units, shell and cost. | 09 | 17 |
| 3. | **Network Integration**<br>Super targeting, Continuous targeting, Maximum energy recovery (MER), Network for multiple utilities and multiple pinches, Grand composite curve (GCC). | 09 | 16 |
| 4. | **Mass Exchange Network Synthesis**<br>Waste water targeting and system design. | 08 | 09 |

| Section II | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction**<br>Basic Concepts of Optimization, Objective function, Model fitting, Regression analysis. | 06 | 08 |
| 2. | **Unconstrained Optimization**<br>Single Variable Optimization: one-dimensional search techniques, Multivariable optimization: direct & indirect methods of first and second order, Simplez method, Newton's method. | 10 | 18 |
| 3. | **Constrained Optimization**<br>Linear Programming (LP) and application: Graphical solution for solving LP problem, simplex method, duality in LP. Non-Linear Programming (NLP) and application: the Langrange multiplier methods, quadratic programming. | 08 | 15 |
| 4. | **Applications of Optimization** | 06 | 09 |

**List of Practical:**

| Sr. No | Name of Practical | Hours |
|---|---|---|
| 1. | Plotting Composite Curve in Excel | 02 |
| 2. | Tutorial on Pinch Technology | 04 |
| 3. | Plotting Grand Composite Curve in Excel | 04 |
| 4. | Area Targeting in Excel | 08 |
| 5. | Mass exchange network diagram in Excel | 02 |
| 6. | Tutorial from module -01 | 02 |
| 7. | Practical on multivariable optimization in Excel | 02 |
| 8. | Practical on Linear Programming | 02 |
| 9. | Practical on Non- Linear Programming | 02 |
| 10. | Tutorial on Lagrange Multiplier Methods | 02 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Pinch Analysis and Process Integration: A user guide on process integration for the efficient uses of energy (2nd edition) | Ian C. Kemp | Butterworth-Heinemann (2007) |
| Optimization of Chemical Processes (2nd edition) | Thomas F. Edgar, David M. Himmelblau and L. S. Lasdon | McGraw Hill (2005) |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Chemical Process Design & Integration (2nd edition) | Robin Smith | Wiley Publishing House |

| | | |
|---|---|---|
| Systematic Methods of Chemical Process Design (1st Edition) | Beigler L. T., Grossman I. E., Westerberg A. W. | Prentice Hall |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103/107/103107094/
- https://simplicable.com/new/process-integration

**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.

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

- understand the concept of pinch in mass and energy exchange network and be able to calculate the targets.
- apply process integration techniques in various heat and mass transfer processes.
- classify process models and formulate verbal optimization problem into a mathematical expression in the form of objective function and identify constraints and bounds.
- use commercial optimization problem solvers and will be able to apply principles of optimization in chemical engineering process design/operation improvement.

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## Department of Chemical Engineering

Course Code: SECH4041
Course Name: Chemical Engineering Plant design, Economics & Industrial Management
Prerequisite Course(s): SECH3071 - Chemical Process Technology

**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

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

- deal with design aspect, selection of equipment, importance of utilities and auxiliaries for any process industries.
- deal with various cost involve in industrial processes, capital investments and investment returns.
- fill the gap between technical knowledge commercial sustainability of any plant by imparting brief description of any plant from top to bottom approach.

**Course Content:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction**<br>Basic Considerations in Chemical Engineering Plant Design, Optimization & Feasibility of Plant Design | 03 | 05 |
| 2. | **Process Design Aspects**<br>Selection of Process-Factors Affecting Process Selection. Types of Project Design, Importance of Laboratory Development Pilot Plant, Safety Factors, Types of Flow Diagrams | 06 | 15 |
| 3. | **Selection of Process Equipment**<br>Standard Versus Special Equipment-Material of Construction for Process Equipment, Selection Criteria, and Specification Sheets | 03 | 05 |
| 4. | **Process Auxiliaries and Process Utilities**<br>Piping Design, Layout, and Supports for Piping Insulations. Pipe Fittings, Types of Valves, Selection of Valves, Process Control and Instrumentation Control System Design. Process Water, Boiler Feed Water, Water Treatment, Waste Treatment and Disposal, Disposal, Steam, Oil Heating System, | 06 | 15 |

| | | | |
|---|---|---|---|
| | Chilling Plant, Compressed Air and Vacuum | | |
| 5. | **Plant location and layout**<br>Factors Affecting Plant Location, Factors in Planning Layouts, Principles of Plant Layout, Use of Scale Models | 05 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Cost Estimation**<br>Cash Flow and Cumulative Cash Position for Industrial Operations, Factors Affecting Estimation of Investment and Production Cost, Breakeven Point and Its Significance, Total Capital Investment, Fixed and Working Capital Investment & Their Estimations, Type of Estimates, Cost Indexes, Method for Estimating Capital Investment | 05 | 10 |
| 2. | **Estimation of Total Product Cost**<br>Estimation of Total Product Cost: Manufacturing Cost, General Expenses, Manufacturing Cost: Direct Production Cost, Fixed Charges, Plant Overhead Cost. | 04 | 10 |
| 3. | **Depreciation**<br>Types of Depreciation, Method for Determining Depreciation: Straight Line Method, Decline Balance Method, Sum of the Year Digit Method, Shrinking Fund Method etc, Single Unit and Group Depreciation, Adjustment of Depreciation Account, Evaluation of Depreciation Methods | 05 | 10 |
| 4. | **Profitability, Alternative Investments and Replacement**<br>Methods for Profitability Evaluation, Evaluation of Break Even Point, % Rate of Return, Practical Factors in Alternative Investment and Replacement Studies. | 04 | 10 |
| 5. | **Project Management**<br>Planning of Project Schedule by BAR CHART, Inventory Control Scheduling a Project using CPM/PERT Methods. | 04 | 10 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Plant design and Economics for Chemical Engineers | M.S. Peters and Timmerhaus | McGraw Hill 3rd Edition |
| Chemical Engineering Plant Design | F.C. Vibrandt and C.E. Dryden | McGraw Hill 5th Edition |

**Reference Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Industrial Engineering and Management | O. P. Khanna | Dhanpat Rai & Sons, 1985 7th Edition |

**Web Material Link(s):**

- https://nptel.ac.in/courses/103103039/

**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.

**Course Outcome(s):**

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

- learn basic economic concept, to understand and apply these concepts in the project works undertaken and to chemical engineering situation by solving problem.
- carry out the primary techno-economic feasibility of project.
- select appropriate process for a project.
- differentiate the equipment and able to prepare specification sheet.
- understand piping and instrumentation diagram.
- evaluate the project cost including capital investment, product cost, breakeven point, depreciation cost for equipment and the total project cost.
- control and schedule of the project using CPME/PERT technique, calculations.
- solve problem on profitability and replacement analysis.

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## Department of Chemical Engineering

Course Code: SECH4510
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 | 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

- 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:**

| **Section I** | | | |
|---|---|---|---|
| Module No. | Content | Hours | Weightage in % |
| 1. | **Introduction to Process Modeling** Systematic Approach to Model Building, Classification of Models. Conservation Principles, Thermodynamic Principles of Process Systems | 05 | 10 |
| 2. | **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 |
| 3. | **Development of Grey Box Models** Empirical model building. Statistical model calibration and validation. Examples. Introduction to population balance models, multi-scale modeling. | 09 | 20 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Solution Strategies for Lumped Parameter Models and Stiff Differential Equations** | 10 | 20 |

| | | | |
|---|---|---|---|
| | Solution Methods for Initial Value and Boundary Value Problems. Euler's Method. R-k Methods, Shooting Method, Finite Difference Methods – Predictor Corrector Methods. | | |
| 2. | **Solution Strategies for Distributed Parameter Models** Solving parabolic, elliptic and hyperbolic partial differential equations. Introduction to finite element and finite volume methods. | 10 | 20 |
| 3. | **Solving Problems using MATLAB** | 03 | 10 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Process Modeling, Simulation and Control for Chemical Engineers (2nd edition) | W.L. Luyben | McGraw Hill Book Co., New York (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 completion of the course, the student will be able to

- develop process models based on conservation principles and process data;
- understand computational techniques to solve process models;
- use simulation tools.

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**School of Engineering**

## Department of Chemical Engineering

Course Code: SECH4520
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 | 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 importance of quality
- learn about ISO management systems
- know the tools for quality improvement
- analyze 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:**

| **Section I** | | | |
|---|---|---|---|
| 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 and CBER) Pharmaceutical Inspection Convention(PIC), WHO and EMEA Covering: Organization and Personnel Responsibilities, Training, Hygiene and Personal Records, Drug Industry Location, Design, Construction and Plant Lay Out, Maintenance, Sanitation, Environmental Control, Utilities | 07 | 18 |

| | | | |
|---|---|---|---|
| | and Maintenance of Sterile Areas, Control of Contamination and 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: Tablets, Capsules, Ointments, Suppositories, Creams, Parenterals, Ophthalmic and Surgical Products (How to Refer Pharma Copoeias). | 08 | 18 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **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 an Electronic Common Technical Documentation (CTD, eCTD). Concept of regulated and non regulated markets. | 12 | 25 |
| 2. | **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 |

**Text Book(s):**

| Title | Author/s | Publication |
|---|---|---|
| Quality Assurance Guide by organization of Pharmaceutical Procedures of India | D H Shah | 3rd revised 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 completion of the course, the student will be able to

- define importance of quality.
- give information about ISO management systems.
- exhibit tools for quality improvement.
- analyze issues in quality.
- do quality evaluation of pharmaceuticals.

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

## Department of Chemical Engineering

Course Code: SECH4530
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 | 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**<br>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**<br>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**<br>Transport Mechanism in NF Membranes, Parameters affecting the Performance of NF Membranes, Fouling Model, Determination of Various Resistances | 06 | 10 |
| 4. | **Ultrafiltration**<br>Factors Affecting Performance of Ultrafiltration, Resistance Model, Gel Polarization Model, Fouling and Flux Decline, Micellar-Enhanced Ultrafiltration, Affinity Ultrafiltration, | 05 | 10 |

| | | | |
|---|---|---|---|
| | Microfiltration Advances | | |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Membrane Gas Separation**<br>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 |
| 2. | **Pervaporation**<br>Mass Transfer and Thermodynamics Aspects of Pervaporation, Temperature Drop at Membrane Interface | 05 | 10 |
| 3. | **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 |
| 4. | **Membrane Reactor**<br>Membrane Bioreactor, Membrane Distillation | 04 | 10 |

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

- apply various transport models for the calculation of membrane fluxes and the extent of separation for various membrane systems.
- identify the types of experimental data needed for the calculation of membrane parameters
- select a membrane process and design components to carry out a specific separation
- apply advanced membrane techniques to solve environmental as well as chemical industries problems.
- review the importance and relevance of separation process with the help of membrane in industry.

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

## Department of Chemical Engineering

Course Code: SECH4540
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 | 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

- 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:**

| **Section I** | | | |
|---|---|---|---|
| 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 | 06 | 17 |

| | | | |
|---|---|---|---|
| | Machinery- Over Pressure Protection, Pressure Relief Devices and Design, Fire Relief, Vacuum and Thermal Relief, Special Situations, Disposal- Flare and Vent Systems Failures In Pressure System. | | |
| 4. | **Plant Commissioning**<br>Commissioning Phases and Organization, Pre-Commissioning Documents, Process Commissioning, Commissioning Problems, Post Commissioning Documentation | 04 | 10 |
| 5. | **Plant Inspection**<br>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 | 05 | 10 |
| **Section II** | | | |
| Module No. | Content | Hours | Weightage in % |
| 1. | **Plant Maintenance, Modification and Emergency Planning**<br>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 |
| 2. | **Storages and Transportation**<br>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 |
| 3. | **Plant Operations**<br>Application of Shell Balance Method and Equations of Changes 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 | 08 | 20 |

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

- become familiar of safe design of equipment which are the essential to chemical industry and leads to design of entire process industries.
- be able to understand the design of pressure systems.
- understand the problems and find innovative solutions while industries facing problems in commissioning and maintenance stages.
- be able to prepare the emergency planning for chemical industry problems.
- be would be able to create safe storage systems.



**P P Savani School of Engineering**
P P Savani University Campus, NH 48, GETCO, Near Biltech,
Village: Dhamdod, Kosamba, Dist.: Surat – 394125