Bansilal Ramnath Agarwal Charitable Trust’s
Vishwakarma Institute of Technology
(An Autonomous Institute affiliated to University of Pune)

Structure & Syllabus of
B.Tech. (Chemical Engineering)
Pattern ‘A14’

Effective from Academic Year 2013-14

Prepared by: - Board of Studies in Chemical Engineering

Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Signed by,

Chairman – BOS    Chairman – Academic Board
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## Module IV, S.Y. B.TECH. Chemical Engineering

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Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Unit-1
Introduction to Ordinary Differential Equations
A. Intro. & Basic concepts, Separable DE & numerical, Second & higher order DE , Second order homogeneous DE with const coefficients, Case of complex roots & exponential functions & numerical, Euler - Cauchy Eq. & numerical, Revision of analytical methods & Basics of numerical solutions of DE
B. System of DE, Euler's Method & RK-4 Method

Unit-2
Engineering Applications of Ordinary Differential Equations
A. Engineering Applications of DE: Analysis of chemical drainage from a storage tank, Analysis of Compound diffusion, Simultaneous reactions in PFR, Temp & Conc analysis for a non-isothermal batch reaction ,Other Engineering Applications: Simulating transient current for RLC Circuit (Electrical Engg.),Motion of a damped spring-mass system (Mechanical Engg.),
B. Conduction in heated plane surface (Aerospace Engg.), Deflection of sailboat mast (Environmental Engg.)

Unit-3
Laplace Transform, Vector Algebra & Complex Numbers
A. Intro. To LT & Basic derivations, Linearity of LT & first shifting theorem ,LT of first & higher order derivatives ,Solution of DE using LT & LT of the integral of a function ,Convolution Theorem & Commutative, distributive & associative laws ,Intro & basics of vector algebra, Vector addition & scalar multiplication, Dot & Cross products , Gradient of a scalar field, Directional derivatives, Divergence & curl of a vector field ,Green's theorem in the plane, Stoke's theorem, Green's Theorem as a special case of Stoke's theorem, Intro. To complex numbers, Basic addition, subtraction, multiplication & division operations, complex conjugates, Complex plane, polar form of complex numbers.

Unit 4
Introduction to Partial Differential Equations
A. Intro & basic concepts of PDEs, Steady-state problems with dirichlet boundary conditions (Elliptic eq.) ,Steady-state problems with derivative & irregular boundaries ,Control volume approach & numerical, Space-time variable problems (Parabolic equations) & Numerical, Basics of numerical solutions of PDEs B. Central difference & Crank-Nicolson's Method.

Unit-5
Engineering Applications of Partial Differential Equations
A. Engineering Apps of PDE: Temperature of a heated plate with dirichlet boundary conditions, Temperature of a heated plate with irregular boundary, Explicit & implicit solution for 1-D heat conduction problem, Deflection of a simply supported square plate with areal load ( Civil Engg. ),Two dimensional electrostatic filed problems (Electrical Engg.)
B. Heated plate with insulate edge & irregular boundary, Crank-Nicolson solution to the heat conduction eq.

Text Books

Reference Books

Additional Reading

Course Outcomes:
The student will be able to –
Solve first and higher order ODEs using analytical and numerical methods.
Solve ODEs resulting from diverse engineering applications in the fields of mechanical, civil, environmental, town planning, chemical engineering
Solve single and simultaneous ODEs using Laplace Transform.
Classify PDEs and solve using various numerical methods.
Solve major three types of engineering PDEs resulting from diverse engineering applications.
CH 20102 :: CHEMICAL ENGINEERING THERMODYNAMICS

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Unit I  (8 Hrs)
Thermodynamic Properties of Fluids
A. Maxwell relationships, homogeneous phases, residual properties, residual properties by equations of state, two-phase systems
B. Clausius - Clapeyron equation, tables and diagram of thermodynamic properties.

Unit II  (7 Hrs)
Solution Thermodynamics
A. Fundamental property relations, chemical potential, criteria for phase equilibrium, partial properties, ideal gas mixtures, fugacity and fugacity coefficients for pure species, for species in solution, ideal solutions,
B. generalized correlations, van Laar equation,

Unit III  (7 Hrs)
Solution Thermodynamics Applications
A. Excess properties, VLE data- fugacity, Activity coefficients, Excess Gibb’s energy, Margules equation, NRTL, UNIQUAC
B. Wilson, Property changes of mixing

Unit IV  (9 Hrs)
Phase Equilibria
A. Vapour – liquid equilibrium: The nature of equilibrium, criteria of equilibrium, phase rule, Duham’s theorem, Raoult’s law, VLE by modified Raoult’s law, dew point and bubble point calculations, Flash calculations, Determine whether azeotrope exist, Equilibrium and stability
B. liquid -liquid equilibrium, solid liquid equilibrium, VLL equilibrium

Unit V  (9 Hrs)
Chemical Reaction Equilibria
A. Criteria for equilibrium to chemical reactions, the standard Gibbs free energy change and the equilibrium constant. Effect of temperature on equilibrium constant, evaluation of the equilibrium constant, relation of equilibrium constant to composition, calculation of equilibrium conversion for single reaction
B. The phase rule and Duhem’s theorem for reacting systems, multireaction Equilibria

Text Books

Reference Books

Course Outcomes:
The student will be able to –

- estimate thermodynamic properties of pure substances in gas or liquid state.
- estimate important thermodynamic properties of ideal and real mixtures of gases and liquids.
- solve complex chemical engineering problems using thermodynamic concepts, data and models.
- analyze phase equilibria in two-component system and generate VLE data.
- analyze chemical reaction equilibria and use standard heats and free energies of formation to evaluate equilibrium constants and determine equilibrium.
CH 20104: HEAT TRANSFER

Credits: 03
Teaching Scheme: Theory 3 Hrs Hours / Week

Unit 1: Conduction
Part A:
Introduction to heat transfer, conduction heat transfer, convection heat transfer, radiation heat transfer. Fourier’s law of heat conduction, thermal conductivity, general differential equation for conduction heat transfer, steady state heat conduction through a plane slab, composite slab, hollow cylinder, composite cylinder and hollow sphere, thermal insulation and critical thickness of insulation.
Part B:
Thermal conductivity of materials, insulators, engineering applications of heat transfer.

Unit 2: Convection without Phase Change
Part A:
Newton’s law of cooling, individual and overall heat transfer coefficient, natural and forced convection systems. Heat transfer from extended surfaces with uniform cross section, thermal boundary layer, dimensional analysis in heat transfer, dimensional analysis by Rayleigh’s method and Buckingham’s method.
Part B:
Natural and forced convection systems, different types of fins.

Unit 3: Convection with Phase Change and Radiation
Part A:
Condensation: Modes and features: Theory and derivation of Nusselt’s equation, Condensation on vertical plate and horizontal plate. Heat transfer in boiling liquids: Pool boiling of saturated liquid, Concept of maximum heat flux and critical temperature drop.
Fundamental facts and definition of terms radiation heat transfer, basic equation of heat transfer by radiation, various cases of radiation between two surfaces, the shape factor, radiation shields.
Part B:
Condensers and boilers, radiation heat transfer systems.

Unit 4: Heat Exchangers
Part A:
Classification of heat exchangers, double pipe heat exchangers, Shell and tube heat exchangers, fouling factors, LMTD and NTU methods for heat exchanger calculation to estimate heat transfer area and overall heat transfer coefficient.
Part B:
Different types of heat exchangers, compact heat exchangers.

Unit 5: Evaporation
Part A:
Evaporation, material and energy balance, calculations, performance, capacity and economy, single and multiple effect evaporators, effect of liquid head and boiling point elevation.
Part B:
Different types of evaporators.

Text Books:
Structure & Syllabus of B.Tech., Chemical Engineering – Pattern A14, rev01/06/15

Reference Books:
3. McCabe W.L., Smith J.C., Peter Harriott; Unit Operations of Chemical Engineering; 7th edition; McGraw Hill

Course Outcomes:
The student will be able to –
1. Distinguish between mechanisms of heat transfer
2. Derive basic heat transfer equations from first principles
3. Solve heat transfer problems using empirical correlations
4. Design simple heat exchangers
5. Do basic evaporator calculations
Credits: 3

Teaching Scheme: 3 Hours / Week

Unit 1: Structural Effect and Reactivity
A. Benzene and aromaticity, concept of aromaticity (4n+2), conditions necessary for demoralization, breaking and formation of bonds (Reaction intermediate). Factors affecting electron availability – Inductive effect, Resonance effect (resonance structures of naphthalene, anthracene, aniline, phenoxide ion, benzaldehyde, nitrobenzene, etc.), hyperconjugation, steric effect, tautomerism. Structure of organic molecules. Acidity, basicity and pKa. Types of reactions, types of reagents.
B. Acidity and basicity of organic compounds, pKa and pHb terms.

Unit 2: Reaction Mechanisms-I (8 Hours)
B. Chemoselectivity

Unit 3: Reaction Mechanisms-II (8 Hours)
B. Classification of organic reactions, Carbanion and free radical generation and their stability order.

Unit 4: Stereochemistry and Heterocyclic compounds (8 Hours)
B. Conformational isomerism of monosubstituted cyclohexane, Problems on designation of organic compounds. Synthesis and application of ionic liquids.

Unit 5: Equilibria, rates and mechanisms (8 Hours)
A. Equilibrium constant variation with the reactant and product, product formation, entropy of reaction, Equilibrium constant variation with the temperature. Kinetics of reaction. Kinetic versus thermodynamic products, solvents effects in product formation. Determination of reaction mechanism- Hammet relationship, detection of intermediates. Spectrophotometric determination of Structure & Syllabus of B.Tech., Chemical Engineering – Pattern A14, rev01/06/15
organic structures.

B. Methods for investigation of mechanism. Spectrophotometric analytical tools study.

Text Books: (As per IEEE format)

Reference Books

Course Outcomes:
The student will be able to –
1. Find out the structure and activity of organic compounds with the help of Hückel’s rule, pKa and pKb value and spectrophotoochemical behavior.
2. Find out intermediate and mechanism of organic compounds.
3. To select the reagents and physical and chemical conditions to carry out the desired reaction.
4. Get the stereo chemical structure and activity of organic compounds and synthesis mechanism of heterocyclic compounds.
5. Find out the effect of solvents on the reaction rate and the product.
Course Outcomes:
The student will be able to –

1. Quantify the factors related to pollution of environment and use environmental education and management process for solving of environment pollution.
2. Analyze different types of Air, Water and Land Pollution and its treatment procedures.
3. Development of environmental management technique and its evaluation technique.
4. Quantize different types of environmental related problems with a particular Act and governmental rules regarding control of pollution.
5. Quantify the risk associated with the hazardous and electronic waste

Unit 1: Overview of pollution & Environment (5 Hrs)
1. Introduction, Man Interfaces with environment, Components & factors affecting environment, Types of environment, Different Eco systems, Environmental management, its objectives and components, Environmental education, its objectives and principles, Word and Environment, India and Environment.

Unit 2: Water Pollution (7 Hrs)
2. Water pollution in process and petrochemical industries.

Unit 3: Air pollution (5 Hrs)
1. Sources and effects, Air pollution sampling & measurements, Air pollution control methods and equipments, Control of specific gaseous pollutants, particulate matter, Noise pollution.
2. Air pollution process and petrochemical industries.

Unit 4: Land pollution & solid waste management (6 Hrs)
1. Land pollution by different sources and its effects, Control of land pollution and strategies, Solid waste sources, types & its effects, Solid waste characteristics, collection and transportation, Solid waste management, disposal, waste processing and recovery.

Unit 5: Environmental standards and legislations (5 Hrs)
2. Central and State pollution control board’s standards and norms for environment.

Text Books:-
1) P. Venugopala Rao; ‘Textbook of Environmental Engineering’; Prentice Hall of India, 2002;

Reference Books:-
1) A.P.Sincero&G.A.Sincero; ‘Environmental Engineering’; Prentice-Hall of India Pvt. Ltd. 2010
2) Jerry A. Nathanson; ‘Basic Environmental Technology’; Prentice-Hall of India Pvt. Ltd., 2005
CH 21202 :: DIFFERENTIAL EQUATIONS (Tutorial)

Credits: 01

Teaching Scheme: - Tutorial 1 Hr/Week

List of Contents

Solution of numerical based on Unit I to Unit V from Differential Equations course.

Text Books


Reference Books


Additional Reading


Course Outcomes:

The student will be able to –
Solve first and higher order ODEs using analytical and numerical methods.
Solve ODEs resulting from diverse engineering applications in the fields of mechanical, civil, environmental, town planning, chemical engineering
Solve single and simultaneous ODEs using Laplace Transform.
Classify PDEs and solve using various numerical methods.
Solve major three types of engineering PDEs resulting from diverse engineering applications.
CH 20202 :: CHEMICAL ENGINEERING THERMODYNAMICS (Tutorial)

Credits: 01

Teaching Scheme: - Tutorial 1 Hr/Week

List of Contents

Solution of numerical based on Unit I to Unit V from Chemical Engineering Thermodynamics course.

Text Books

Reference Books

Course Outcomes:
The student will be able to –
1. estimate thermodynamic properties of pure substances in gas or liquid state.
2. estimate important thermodynamic properties of ideal and real mixtures of gases and liquids.
3. solve complex chemical engineering problems using thermodynamic concepts, data and models.
4. analyze phase equilibria in two-component system and generate VLE data
5. analyze chemical reaction equilibria and use standard heats and free energies of formation to evaluate equilibrium constants and determine equilibrium.
CH 20304: HEAT TRANSFER LABORATORY

Credits: 01
Teaching Scheme: Laboratory 2 Hrs/Week

List of Practical
Required to perform minimum 6-8 practical from the list given below:

1. Determination of thermal conductivity of insulating powder
2. Determination of thermal conductivity of composite wall
3. Determination of thermal conductivity of a metal rod and to study effect of temperature on its thermal conductivity.
4. Determination of heat transfer coefficient for convection heat transfer
5. Determination of efficiency and effectiveness and efficiency of fin
6. Verification of Stefan-Boltzmann constant
7. Determination of emissivity of a nonblack surface
8. Determination critical heat flux in pool boiling
9. Analysis of heat exchangers performance in double pipe heat exchanger

Text Books:

Reference Books:
3. McCabe W.L., Smith J.C., Peter Harriott; Unit Operations of Chemical Engineering; 7th edition; McGraw Hill

Course Outcomes:
The student will be able to –
1. Determine thermal conductivity of various materials experimentally
2. Determine heat transfer coefficient in convection experimentally
3. Determine emissivity and verify radiation basic laws experimentally
4. Solve heat transfer problems using empirical correlations
5. Analyze the performance of double pipe heat exchanger
CH 20306 :: CHEMISTRY LABORATORY

Credits: 01  
Teaching Scheme: - Laboratory 2 Hrs/Week

List of Practical
1. Purification of organic compound by recrystalization and sublimation and to find their physical constants (any two compounds).
2. Organic qualitative analysis - preliminary tests, type, elements, functional group and physical constants- atleast one function from each type.
3. Acids- benzoic acid, salicylic acid, phthalic acid, oxalic acid, acetic acid.
4. Phenols- □ naphthol, □ naphthol, resorcinol, O-nitrophenol, P-nitrophenol
5. Bases- Aniline, p-toluidine, diphenylamine
6. Neutral- Benzaldehyde, glucose, acetone, ethylmethyl ketone, ethyl acetate, naphthalene, nitrobenzene, urea, thiourea, m- dinitrobenzene.
7. Preparation of m-dinitroaniline from nitrobenzene.
10. Methyl orange- Theory explanation and analysis of product.

Text Books

Reference Books

Course Outcomes:
The student will be able to –
1. Purify organic compounds by physical methods.
2. get qualitative analysis data of an organic compounds.
3. Synthesize few organic compounds e.g. methyl orange etc.
4. Get melting point and boiling point of any organic compound.
5. Give mechanism of synthesis of organic compounds.
CH 21304: ENVIRONMENTAL ENGINEERING LABORATORY

7. Credits: 01 Teaching Scheme: - Laboratory 2 Hrs/Week

8. Course Outcomes
   1. The student will be able to find parameters like BOD, COD, alkalinity, acidity, hardness of waste water samples.
   2. The student will be able to characterise and analyse the water from various industries.
   3. The student will be able to determine alkalinity, acidity, hardness of waste water samples.
   4. The student will be able to Test and analyse the sample using appropriate method.
   5. The student will be able to analyze different types of natural resources and their pollution related to environment and surroundings.

List of Practicals
   1. Waste water sample preparation and dilution
   2. To determine the alkalinity of waste water samples
   3. To determine the acidity of water samples
   4. To determine the hardness of water samples
   5. To determine the Dissolved Oxygen of water samples
   6. To determine BOD of waste water samples
   7. To determine COD of waste water samples
   8. To determine the surfactant concentration in waste water samples
   9. Removal of contaminants from water samples by adsorption
  10. Removal of heavy metals from water samples

Text Books:-
   1. Dr.Sunita Rattan, ‘Experiments in Applied Chemistry’, S.K. Kataria & Sons publishers
   3. B.K. Sharma, 'Environmental Chemistry', Goel Publishing House

Reference Book:
## Skill Development Courses (SD3/SD4), S.Y. B.TECH. Chemical Engineering

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CH 24301 :: COMPUTING IN MS EXCEL

Credits: 01  Teaching Scheme: - Laboratory 2 Hrs/Week

List of Practical (any 8)

1. Introduction to Ms Excel & basic commands.
2. Introduction to higher level commands.
4. To study material balance problems with excel.
5. To study energy balance problems with excel.
6. Import & Export of data.
7. Solving Heat transfer problem with excel
8. Solving Process Calculation problem with excel
9. Different operation on Matrix with excel
10. Solving different numerical methods.
11. To study preparation of mass balance.
12. Interfacing of excel with Mat lab.

Text Books


Reference Books


Course Outcomes:
The student will be able to –
1. solve various problems with the use of a spreadsheet for technical computations
2. to use the numerical routines provided in MS Excel to carry out computational tasks..
3. solve different Chemical engineering problems with numerical methods.
4. calculate mass balance around single equipment.
5. link data between different spreadsheet.
CH 24302 :: CHEMICAL SYNTHESIS

Credits: 01     Teaching Scheme: - Laboratory 2 Hrs/Week

List of Practical

1. Synthesis of Aspirin- different route of synthesis, explanation, and analysis of product.
2. Halogenation of cyclo alkanes- Theory explanation, and analysis of product.
5. Alizarin - Theory explanation, and analysis of product.
7. Sudan-I- Theory explanation, and analysis of product.
8. Cinnamic acid (Perkin's reaction) – Theory explanation, and analysis of product.
9. Benzoylacetone (Claisen's reaction) – Theory explanation, and analysis of product.

Text Books


Reference Books


Course Outcomes:

The student will be able to –

1. Synthesize organic compounds by oxidation reactions and multiple step synthesis reactions.
2. Analyze qualitative analysis of organic compounds.
4. Synthesize artificial chemical dyes.
5. Analyze and perform electrophilic aromatic substitution reactions.
CH 24303: PIPE STRESS ANALYSIS USING CAESAR-II

Credits: 01  
Teaching Scheme: Laboratory 2 Hrs/Week

**List of Practical**

Around Two Practical per unit on the topic mentioned below:

1. Given a line sketch isometric - Input pipe run data into CAESAR-II
2. select pipe supports as given and Entering vendor data into CAESAR-II and learn stress calculation; changes for various nations.
3. Static pipe stress analysis. Use XYZ coordinates and pipe connection basics as given data and re-do layout and stress analysis simulation. Learn to save costs.
4. Static pipe stress analysis. Solve Tutorial. Linear dynamic analysis. Given pipe network flow simulation data and design constraints that cavitation can occur under certain constraints add static and linear dynamic stress analysis to clear the design to lie much below the maximum allowable stress.
5. Linear dynamic analysis. A Tutorial. Changes in pressure and temperature rating for header (main) and branch pipes modular design (simulation results) and safe piping system design.
6. Pipe network simulation and safety rules as per codes. Re-design piping system to include static and linear dynamic stress analysis. Piping class components and static and linear dynamic stress analysis.
7. Preparation of specification sheets as per ASME Codes and industry job skill
8. Specifications.

**Text Books:**


**Reference Books:**

1. Mohinder Nayyar; Piping Data Handbook; 1st edition; McGraw-Hill Professional

**Course Outcomes:**

The student will be able to –

1. To learn basic concept of pipe stress analysis
2. To analyze for stress analysis of critical lines on CAESAR-II or similar software
3. To learn to select pipe supports for piping system.
4. To be able to select material of construction.
5. To learn to design as per ASME codes and prepare specification sheets.
Credits: 01    Teaching Scheme: Laboratory- 02 Hours / Week

List of Practicals:

1. Waste water sample preparation for testing (2 Experiments each)
2. Study physical properties of waste water (2 Experiments each)
3. Study of chemical properties of waste water (3 Experiments each)
4. Study of biological properties of waste water (2 Experiments each)
5. Study of advance treatment methods for waste water (1 Experiments each)
6. Water and waste water treatment plants industrial visit.

Text Books: (As per IEEE format)

1. S. P. Mahajan; Industrial waste water treatment;

Reference Books: (As per IEEE format)

2. “Water Treatment Unit Processes: Physical and Chemical (Civil and Environmental Engineering)” by David W. Hendricks.

Course Outcomes:
The student will be able to –
1. Collect and prepare the water and waste water samples for analysis.
2. Perform the analysis of waste water sample to identify the level of contaminants.
3. Carry out the experimentation for analysis of physical properties of water samples.
4. Carry out the experimentation for analysis of Chemical properties of water samples.
5. Carry out the advanced waste water treatment experimentation for water treatment.
CH 24305 :: HTRI-BASED HEAT EXCHANGER SIMULATION

Credits: 01  Teaching Scheme: - Laboratory  2 Hrs/Week

Prerequisites: Nil

Objectives:
1. To use HTRI software to design heat exchangers.
2. To learn to use TEMA codes for design of heat exchangers.
3. Mapping with PEOs : 4,5 (c, d, e)

List of Practical
Around Two Practical per unit on the topic mentioned below:
2. TEMA codes and applications in heat exchanger design, various types of industrial specification for design; correlation equation used in heat exchanger design.
3. Shell and tube heat Exchanger; double pipe heat exchanger; exchanger internals and design of heat exchangers; engineering drawings used in industrial practice.
4. Condenser, types of condenser and design; use of TEMA codes.
5. Evaporators, multi- effect evaporator; use of design; specifications used in design.
6. Air cooled heat exchanger; industrial applications and design; chiller design.

Text Books
A) “Process heat transfer” by D.Q.kern.

Reference Books
2. Coulson & Richardson's Chemical Engineering, vol 2.

Course Outcomes:
The student will be able to –
1. To learn basic concept of heat exchanger design.
2. To learn how to select TEMA construction codes based on design and selection factors.
3. To learn to select exchanger internals for a design problem.
4. To be able to select property data from various standard resources.
5. To learn about TEMA vibration test for clearing heat exchanger design.
CH 24306 : INDUSTRIAL VISITS

Credits: 01  
Teaching Scheme: Laboratory 2 Hrs/Week

List of Practical

Students will visit minimum three of the industries such as below mentioned chemical process industries in and around Pune. They will study the whole process before visiting the industry. Also they will make detailed report of the visit immediately after visiting an industry.

1. Inorganic chemical industries.
2. Natural product industries.
3. Synthetic organic chemical industries.
4. Polymerization industries.
5. Metallurgical industries.
6. Pollution control & toxic chemicals industries.

Text Books

1. M. Gopala Rao, Marshall Sittig; Dryden’s Outlines of Chemical Technology- For the 21st Century; Third Edition; Affiliated East-West Press Pvt Ltd; New Delhi

Reference Books

1. Austin, George T.; Shreve's Chemical Process Industries; Fifth Edition; McGraw-Hill

Course Outcomes:
The student will be able to –

1. Visualize and understand the various processes in the chemical process industry
2. Visualize and understand the various processing equipment used in the chemical process industry
3. Understand auxiliary equipment and utility lines in the process plant
4. Learn the process plant layout and equipment layout basics
5. Learn the preliminary idea on process flow, testing, inspection and quality check standards of the process industry
CH 24307 :: ANALYTICAL TECHNIQUES

Credits: 01
Teaching Scheme: - Laboratory  2 Hrs/Week

List of Practicals

Minimum 6 practicals out of the following :
1) Preparation of a spreadsheet using sample data and Statistical tools.
2) Determination of unknown concentration from the given solution using UV-Vis Spectroscopy
3) Separation of one component sample using HPLC
4) Separation of multi component sample using HPLC
5) Separation of one component sample using GC
6) Separation of multi component sample using GC
7) Separation of a sample using Ion Chromatography
8) Volumetric exercise using pH metry.
9) Volumetric exercise using Conductometry.
10) Determination of structural features using refractometry.

Text Books

Reference Books

Course outcomes :
Students will be able to –
1. Identify the technique to be employed for the characterization of a given sample
2. Develop suitable extraction technique for sample preparation
3. Calculate unknown concentration of the target analyte selectively in a given sample
4. Test the samples for the qualitative and quantitative analysis of the analytes
5. Develop methods for the separation and quantification of samples using chromatography
CH 24308 :: SCILAB

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

List of Practical (any 6 to 8)
1. Scilab Basics, Scilab Environment
2. The Workspace and Working Directory
3. Matrix Operations
5. Plotting graph
6. Functions in Scilab.
7. Miscellaneous Commands.
8. Fluid flow problems
9. Problems will be taken from the areas of material and energy balances, kinetics, data fitting and analysis of experimental data.

Text Books

Reference Books

Course out comes

Student will be able to-

1. Recognize the importance of numerical methods in mathematical modeling.
2. Perform basic algebraic and arithmetic computations in the Scilab environment.
3. Write and interpret programs in Scilab programming language.
4. Solve simple numerical problems using interactive Scilab commands.
5. Solve moderately complicated numerical problems by writing Scilab programs.