# C.V. Raman College of Engineering,

(An Autonomous Institute Affiliated to BPUT, Odisha)

Bidyanagar, Mahura, Janla, Bhubaneswar - 752 054 (Orissa)

**Second Year B.Tech Course Structure with effect from Academic Year 2015-16**

**Department of Chemical Engineering**

**Semester III**

| Sl. No. | Code | Subject | Type | Teaching Scheme | | | Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | P | T | |
| S1 | **MA21104** | Mathematics-III(B) | Theory – Core | 3 | - | 1 | 4 |
| S2 | **CH20101** | Fluid Flow & Flow Measurement | Theory – Core | 3 | - | 1 | 4 |
| S3 | **CH20102** | Chemical Process Technology | Theory – Core | 3 | - | - | 3 |
| S4 | **CH20103** | Mass Transfer-I | Theory – Core | 3 | - | - | 3 |
| S5 | **CS21102** | Object Oriented Programming using C++ | Theory – MD | 3 | - | - | 2 |
| P1 | **CH20301** | Fluid Flow & Flow Measurement Lab | Lab – Core | - | 2 | - | 1 |
| P2 | **CH20302** | Chemical Technology Lab | Lab – Core | - | 2 | - | 1 |
| P3 | **CS21302** | Object Oriented Programming using C++ Lab | Lab – MD | - | 2 | - | 1 |
| P4 | **CH24301** | Introduction to Process Automation | Lab – SD | - | 2 | - | 1 |
| MP | **CH27397** | Mini Proj. | Project | - | 4 | - | 2 |
| | **CH27401** | Comprehensive Viva Voce based on S2 & S3 | Oral | - | - | - | 2 |
| P5 | **HS27403** | General Seminar on Communication Soft Skills | Lab | - | 2 | - | 1 |
| **Total:** | | | | **15** | **14** | **2** | **25** |

# MA21104: Mathematics–III (B) [3-0-0]

**Credits:** 04 **Teaching Scheme:** Theory 03 Hrs / Week

**Prerequisites**: Elementary idea of Sets, Functions, Trigonometry, Two–dimensional co-ordinate Geometry, Fundamentals of differential and integral calculus, Ordinary Differential Equations.

**Objectives:**

1. To empower the students with skills to model and solve partial differential equations with comparative ease.
2. To make students aware of Complex Analysis and its applications.

**Unit 1: Partial Differential Equations (08 Hrs)**

**U1.1.** Introduction to Partial Differential Equations. Partial differential equation of first order, Linear partial differential equation (Lagrange's' Method), Non-linear partial differential equation, Charpit's Method, Homogenous and non-homogeneous partial differential equation with constant co-efficient, Cauchy type differential Equations.

**U1.2.** Self Study Topics: Finding integral surface of the differential equations.

**Unit 2: Some More Techniques to Solve PDEs (08 Hrs)**

**U2.1.** Non – Linear Partial Differential Equations of Second Order [Monge's Method], Solution of Second Order PDE, Some Miscellaneous Cases, Solutions of Partial Differential Equations by Separation of Variables, Solution of Parabolic, Hyperbolic Partial Differential Equations.

**U2.2.** Self Study Topics: Solutions of PDE by Applying Laplace's Transforms.

**Unit 3: Wave, Heat, and Laplace's Equations (08 Hrs)**

**U3.1.** One and two dimensional wave equations and their solutions, one and two dimensional heat equations and their solutions, D'Alembert's Solution of Wave Equation, Solutions of Laplace's Equations in Cartesian, Polar Forms, cylindrical and spherical polar forms.

**U3.2.** Self Study Topics: Transmission line Equations.

**Unit 4**: **Complex Analytic Function and Conformal Mapping (08 Hrs)**

**U4.1.** Complex Numbers, Complex Plane, Polar form of Complex Numbers, Powers and Roots, Analytic function, Cauchy-Riemann equations, Laplace equation, Complex Exponential, Trigonometric, Hyperbolic, and Logarithmic Functions, conformal Mapping and Linear Fractional Transformations.

**U4.2.** Self Study Topics: Riemann Surfaces.

**Unit 5: Complex Integration and Power Series (08 Hrs)**

**U5.1.** Complex integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions. Taylor Series, Laurent's series, Singularities and zeros, Residue integration method.

**U5.2.** Self Study Topics: Complex Analysis Applied to Problems of Heat and Fluid flow.

**Note:** Five assignments to be given to the students for self study comprising of one assignment from each unit.

**Text Books:**

T1. Advanced Engineering Mathematics, Erwin Kreyszig, John Willy and Sons, 8th Edition, 1999. Chapters: 11(11.2 - 11.5, 11.9, 11.11), 12(12.1 – 12.8), 13(13.1 – 13.4), 14(14.1-14.4), 15(15.1 – 15.4).

T2. Higher Engineering Mathematics, B.V. Ramanna, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1st Reprint, 2007. Chapters: 18(18.1 – 18.8).

**Reference Books:**

R1. Engineering Mathematics, S. Pal and S.C. Bhunia Oxford Publishers, 1st Edition, 2014.

R2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 43rd Edition, 2014.

R3. Advanced Engineering Mathematics. Jain and Iyangar, Narosa Publishing House, 4th, 2014 (Reprint).

R4. Advanced Engineering Mathematics. P. V. O'Neil, CENGAGE Learning, 7th Edition, 2012.

R5. Fundamental of Complex Analysis, E.B. Saff, A. D. Snider, Third Edition, Pearson Education, New Delhi, 2008.

R6. A Course on Ordinary and Partial Differential Equations, J. Sinha Roy and S. Padhy, Kalyani Publishers, Fourth Edition, 2014.

## MA21104: Mathematics–III (B) [0-0-1]

**Teaching Scheme:** Tutorial 01 Hr / Week

**Prerequisites**: Elementary idea of Sets, Functions, Trigonometry, Two –dimensional co-ordinate Geometry, Fundamentals of differential and integral calculus of 10+2 standard

**Objectives:**

**1.** To empower the students with skills to model and solve partial differential equations with

comparative ease.

**2.** To make students aware of Complex Analysis and its applications.

**List of Contents:**

**Tutorial No. 1:** Problem solving involving Formation of PDEs and Solving Linear PDE by Lagrange's Method.

**Tutorial No. 2:** Problem solving involving Non-linear PDE by Charpit's Method.

**Tutorial No. 3:** Problem solving involving Linear PDE.

**Tutorial No. 4:** Problem solving involving One Dimensional Wave Equation.

**Tutorial No. 5:** Problem solving involving Heat Equation.

**Tutorial No. 6:** Problem solving Involving Laplace's Equation.

**Tutorial No.7:** Problem solving involving Complex Analytic functions and Cauchy-Rieman Equations.

**Tutorial No. 8:** Problem solving involving Conformal Mapping.

**Tutorial No.9:** Problem solving involving Complex Exponential, Trigonometric, Hyperbolic and Logarithmic Functions.

**Tutorial No. 10:** Some problems for practice involving Complex Integration.

**Tutorial No. 11:** Some problems for practice on Taylor and Laurent Series.

**Tutorial No. 12:** Some problems for practice on Residue Integration Method.

**Text Books:**

T1. Advanced Engineering Mathematics, Erwin Kreyszig, John Willy and Sons, 8th Edition, 1999. Chapters: 11(11.2 - 11.5, 11.9, 11.11), 12(12.1 – 12.8), 13(13.1 – 13.4), 14(14.1-14.4), 15(15.1 – 15.4).

T2. Higher Engineering Mathematics, B. V. Ramanna, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1st Reprint, 2007. Chapters: 18(18.1 – 18.8).

**Reference Books:**

R1. Engineering Mathematics, S. Pal and S.C. Bhunia Oxford Publishers, 1st Edition, 2014.

R2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 43rd Edition, 2014.

R3. Advanced Engineering Mathematics. Jain and Iyangar, Narosa Publishing House, 4th, 2014 (Reprint).

R4. Advanced Engineering Mathematics. P. V. O'Neil, CENGAGE Learning, 7th Edition, 2012.

R5. Fundamental of Complex Analysis, E.B. Saff, A. D. Snider, Third Edition, Pearson Education, New Delhi, 2008.

R6. A Course on Ordinary and Partial Differential Equations, J. Sinha Roy and S. Padhy, Kalyani Publishers, Fourth Edition, 2014.

## CH20101: Fluid Flow & Flow Measurement [3-0-0]

**Credits:** 04 **Teaching Scheme:** Theory 03 Hrs / Week

**Prerequisites**: Nil

**Objectives:** Provide students with a basic knowledge in fluid properties and statics utilizing the principles developed in previous mechanics courses.

**Course Details:**

**Unit 1: Fluid statistics and dimensional analysis (06 Hrs)**

**U1.1.** Units and dimensional analysis, Types of Fluids, Fluid as a continuum, Fluid Static: Hydrostatic Pressure, Basic equation of fluid statics; pressure variation in a static field; pressure measuring devices.

**U1.2.** Self Study Topics: Problems based on Buckingham's and Rayleigh methods of analysis.

**Unit 2: Flow measurements and Fluid kinematics (06 Hrs)**

**U2.1.** Introduction to fluids in motion, Flow in boundary layers, Its formation & growth in tubes & plates, Basic equations of fluid flow continuity, momentum & Bernoulli's equation**,** Navier Stokes equation – specific applications, Flow measuring devices; Venturi, Orifice, Pitot tube & Rotameter.

**U2.2.** Self Study Topics: Study of various variable head and variable area meters.

**Unit 3: Flow of incompressible, compressible flows and immersed bodies (06 Hrs)**

**U3.1.** Flow of incompressible fluid in pipes, Relation between skin friction & wall shear. Laminar flow in pipes, Hagen-Poiuilles equation, Friction factor, Friction from changes in velocity or direction, Flow of compressible fluids, Basic equations. Flow past immersed bodies, Drag Co-efficient, concept of equivalent diameter and sphericity; Ergun equation, Motion of particles through fluids. Its mechanics, terminal Velocity.

**U3.2.** Self Study Topics: Study of different types of compressible flows.

**Unit 4: Fluidization and its applications (06 Hrs)**

**U4.1.** Friction inflow through beds of solids, Fluidization, Mechanism of fluidization, pressure drops in fluidization, Application of fluidization.

**U4.2.** Self Study Topics: Design of a fluidized and packed bed.

**Unit 5: Transportation of fluids (06 Hrs)**

**U5.1.** Transportation of fluids, Reciprocating rotary & centrifugal pump, fans, blowers & compressors, Characteristics curves & calculation of power & efficiency of pumps, Concept of slip.

**U5.2.** Self Study Topics: Study of different types of positive displacement pumps.

**Note:** Five assignments to be given to the students on self study, comprising of one assignment from each unit.

**Text Books:**

T1. "A textbook of fluid mechanics and hydraulic machines", R. K. Bansal, Laxmi Publications (P) Ltd., 9th Edition, 2014.

T2. "Unit operations of chemical engineering", Smith and Harriott peter, Tata Mc Graw-hill Higher Education, 7th Edition, 2005.

**Reference Books:**

R1. "Fluid Mechanics", Frank M White, McGraw-Hill Education, 7th Edition, 2010.

## CH20101: FLUID FLOW & FLOW MEASUREMENT [0-0-1]

**Teaching Scheme:** Tutorial 01 Hr / Week

**List of Contents:**

**Tutorial No. 1:** Buckingham's and Rayleigh methods of dimensional analysis also standard unit system used in measurement.

**Tutorial No. 2:** Analysis of various flow meters used in measurement.

**Tutorial No. 3:** Bernoulli's equation for real fluids and study of various variable head and variable area meters with its application.

**Tutorial No. 4:** laminar and turbulent flow description ant its applicability for real systems.

**Tutorial No. 5:** Study of different types of compressible flows for both adiabatic and isothermal process.

**Tutorial No.6:** Study of different types of incompressible flows for both adiabatic and isothermal process.

**Tutorial No. 7:** Mechanism of fluidization and its application.

**Tutorial No. 8:** Design of fluidized bed systems

**Tutorial No. 9:** Design of a packed bed systems and.

**Tutorial No.10:** Use of Ergun equations for calculating pressure drop for both laminar and turbulent region.

**Tutorial No. 11:** Study of flow past immersed bodies.

**Tutorial No. 12:** Study of different types of positive displacement pumps.

**Text Books:**

T1. "A textbook of fluid mechanics and hydraulic machines", R. K. Bansal, Laxmi Publications (P) Ltd., 9th Edition, 2014.

T2. "Unit operations of chemical engineering", Smith and Harriott peter, Tata Mc Graw-Hill Higher Education, 7th Edition, 2005.

**Reference Books:**

R1. "Fluid Mechanics", Frank M White, McGraw-Hill Education, 7th Edition, 2010.

## CH20102: Chemical Process Technology [3-0-0]

**Credits:** 03 **Teaching Scheme:** Theory 03 Hrs/Week

**Prerequisites**: The student is expected to have sound knowledge of intermediate level organic chemistry

**Objectives:** The aim of the course is to study process technologies, availability of raw materials, production trends, preparation of flow sheets, engineering and environmental problems of various chemical industries.

**Course Details:**

**Unit1: Heavy chemicals: Caustic soda and chlorine, caustic soda and chlorine, Hydrochloric acid, Soda Ash, Sulphuric acid (06 Hrs)**

**U1.1.** Electrolytic method of production of caustic soda and chlorine, Elemental Sulfur from ores; Sulfur Oxides, Double contact double absorption method of production of Sulphuric acid, Industrial Gases: $CO_2$, $H_2$, $O_2$, $N_2$ , Water gas, Coke-oven gas and Producer gas. Nitric acid, Hydrochloric acid, phosphoric acid, Sodium chloride, Soda ash, Caustic soda, Chlorine, Bleaching powder.

**U1.2.** Self Study Topics: Electrolytic cell, Acid rain, working of fire extinguisher

**Unit 2: Fertilizer Industry Phosphorous Industry (06 Hrs)**

**U2.1.** Urea, Ammonium chloride, Ammonium nitrate, Ammonium phosphate, Ammonium

sulfate, Production of white and Red Phosphorus, Pentoxide. Super Phosphate, Triple Super Phosphate, DAP and Biofertilizers.

**U2.2.** Self Study Topics: Different Fertilizers used today and their environmental impacts.

**Unit 3: Petroleum Industry and Edible oils (06 Hrs)**

**U3.1.** Constituents of crude petroleum; Production of ethylene, propylene Extraction and purification of oil from oil seeds, use of byproducts from oil production industry, hydrogenation of oil using various catalysts. Soap industry, Saponification process, Manufacture of soap from vegetable oils, various types of detergents, manufacture of Detergents. Various method of application of dyes on the fabrics

**U3.2.** Self Study Topics: By-products of petroleum industry

**Unit 4: Sugar Industry and Paper Industry (06 Hrs)**

**U4.1.** Sources of sugar, raw material for sugar industry, production of sugar from sugarcane. Manufacture of industrial alcohol from various cellulosic sources, byproducts of sugar industry, Conversion of industrial alcohols to absolute alcohol. Manufacture of pulp from various sources, Production of paper from pulp. Dyes and Pigments trends. Various natural and synthetic dyes used in today.

**U4.2.** Self Study Topics : Sugar industry in India, trends in liquor industry, Recycling of paper

**Unit 5: Polymer industry and Rubber industry (06 Hrs)**

**U5.1.** Polymerization process, types of polymerizations, Polymerization, PVC, LDPE, Polypropylene, Cross linked polymers, Rubber Industries: Natural and synthetic rubber and rubber compounding. Other Industries like: Paints, Pigments, Vanishes, Enamel, Lacquers - White Lead and Zinc oxide, Hydrogen peroxide (H2O2), Silicon carbide (SiC), Glass, Cement, Chlorine and Fluorine based industries.

**U5.2.** Self Study Topics: Comparison of synthetic and natural fibers.

**Note:** Five assignments to be given to the students on self study, comprising of one assignment from each unit.

**Text Books:**

T1. "Outlines of Chemical Technology", C.E. Dryden, Edited & revised by M. Gopal Rao & M. Sittig, Affiliated East-West Press, third Edition, 2010.

T2. "Shreeve's Chemical Process Industries", George T. Austin, McGraw Hill,5th Edition, 2012.

**Reference Books**

R1. "Chemical Process Technology", Jacob A. Moulijn, Michiel Makkee, Annelies E. van Diepen, Wiley, 2nd Edition, 2013.

## CH20103: Mass Transfer–I [3-0-0]

**Credits:** 03 **Teaching Scheme:** Theory 03 Hrs / Week

**Prerequisites**: Nil

**Objectives:**

The general objectives of Mass Transfer Operations-I are to discuss the fundamental concepts of mass transfer principles and to apply those concepts to real engineering problems. This course will provide an overview of mass transfer operations at basic to an intermediate level. Coverage will be relatively broad. This course applies the concepts of diffusion mass transfer, mass transfer coefficients, convective mass transfer, interphase mass transfer, equipment for gas-liquid operations, absorption, and distillation. Each topic will be covered in logical sequence with relevant examples. The goal is to provide students with the theoretical/analytical background to understand mass transfer operations and to tackle the sort of complex problems.

**Course Details:**

**Unit 1: Diffusion in mass transfer (06 Hrs)**

**U1.1.** Introduction to Mass transfer operations, molecular diffusion in fluids, binary solutions, Fick's law, equation of continuity, steady state molecular diffusion in fluids at rest and laminar flow, molecular diffusion in gases, steady state equimolal counter current diffusion, diffusivity of gases, molecular diffusion in liquids, diffusivity in liquids

**U1.2.** Self Study Topics: Equipment for gas liquid operation and Mass Transfer Coefficient

**Unit 2: Application of molecular diffusion in mass transfer (06 Hrs)**

**U2.1.** Application of molecular diffusion, mass transfer coefficients, in laminar and turbulent flow, Film theory, Penetration theory, surface-renewal theories, analogy between mass, heat and momentum transfer

**U2.2.** Self Study Topics: Dimensional analysis for mass transfer and its applications, Simultaneous mass and heat transfer.

**Unit 3: Distillation-I (06 Hrs)**

**U3.1.** Principle of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, azeotropic and extractive distillation.

**U3.2.** Self Study Topics: Flooding, weeping, chocking, molecular distillation,

**Unit 4: Distillation-II** **(06 Hrs)**

**U4.1.** Continuous rectification-binary system, the fractionation operation, Ponchon - Savarit method, Continuous distillation: McCabe - Thiele method, feed tray location, increased reflux ratio, total reflux ration, minimum reflux ratio, optimum reflux ratio, Tray efficiencies, introduction to multi component distillation.

**U4.2.** Self Study Topics: Bubble column, reboiler.

**Unit 5: Absorption** **(06 Hrs)**

**U5.1.** Absorption : Equilibrium solubility of gases in liquids, two components system, multi component system, ideal and non - ideal solutions, choice of solvent for absorption, single component absorption material balance, counter current multistage operations, dilute gas mixtures, non - isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU, NTU concepts for single component absorption.

**U5.2.** Self Study Topics: Tray efficiencies, absorption with chemical reaction.

**Textbooks:**

T1. Mass Transfer Operations, R. E. Treybal, McGraw Hill, New York, 3rd Edition, 2001.

T2. Unit Operations in Chemical Engineering Mc-Cabe & Smith., Mc Graw Hill International Edn, 7th Edition, 2009.

T3. Mass Transfer Operations, A. Suryanarayana, New age international publishers, 2009.

**Reference Books:**

R1. Deisgn of Equilibrium Stage Process, B. D. Smith, Mc Graw Hill.

R2. Chemical Engineering, J. M. Coulson and J. F. Richardson, Vol - II, Asian books private Ltd., 2007.

R3.Perry's Chemical Engineers' Handbook, Don W. Green, Robert H., Eighth Edition.

## CS21102: Object Oriented Programming using C++ [3-0-0]

**Credits:** 02 **Teaching Scheme:** Theory 03 Hrs / Week

**Prerequisites**:

1. Knowledge of any programming language.

2. Knowledge of various control structures

3. Knowledge of functions

4. Knowledge of basic I/O mechanisms.

5. Ability to apply logic.

**Objectives:**

1. To get a clear understanding of object oriented programming and C++ concept.

2. Be able to explain the difference between OOP and POP.

3. Be able to program using various C++ features such as operator overloading, dynamic memory allocation, inheritance, polymorphism, exception handling and templates.

4. Be able to build C++ classes using appropriate encapsulation and design principles.

5. To improve the problem solving skills by applying OOP techniques to solve bigger computing problems.

**Course Details:**

**Unit 1: Introduction** **(06 Hrs)**

**U1.1.** Introduction to object oriented programming, Object Oriented Programming paradigm. Basic concepts of object oriented programming, i.e. Object, Class, polymorphism, encapsulation, data abstraction, inheritance, data hiding and message passing.

Getting started with C++ syntax, Input and Output in C++, C++ tokens: Keywords, Identifiers, Constants, Operators. Data-types: user-defined & derived data-types, Reference variables, Dynamic initialization of variables, Special operators in C++ (i.e. scope resolution, new, delete and other operators), Pointers. Functions: Call by reference, Default parameter values in functions, Inline functions.

**U1.2.** Self Study: Control structures, arrays, functions returning reference, Manipulators, Operator precedence.

**Unit 2: Class & Object:** **(06Hrs)**

**U2.1.** Abstraction mechanism: Difference between structure and class, Specifying a class, access specifiers, data members, member functions, array of objects, static members, friend functions, constructors, destructors.

**U2.2.** Self Study: Making an outside function inline, Constructor with default arguments, constant member functions.

**Unit 3: Inheritance:** **(06 Hrs)**

**U3.1.** Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hierarchical, hybrid inheritance, role of virtual base class, constructor and destructor in inheritance.

**U3.2.** Self Study: Initialization list in constructors, Delegation, Nested classes.

**Unit 4: Polymorphism: (06 Hrs)**

**U4.1.** Polymorphism: Binding, Static binding, Dynamic binding. Function Overloading, Ambiguity in function overloading. Operator Overloading: Operator function, member and non member operator function, type conversion.

Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.

**U4.2.** Self Study: this pointer, applications of this pointer, overloading I/O operators, virtual destructors, typeid operator.

**Unit 5: Exception Handling, Template and Namespace (06 Hrs)**

**U5.1.** Exception handling Mechanism: use of try, throw and catch. Generic catch, rethrowing an exception, Specifying exceptions for a function.

Template: Class templates, Function templates, Overloading a function template.

Namespaces: user defined namespaces, namespaces provided by library.

**U5.2.** Self Study: Exception in inheritance, Non-type Template parameter, Standard Template Library.

**Note:** Five assignments to be given to the students on self study, comprising of one assignment from each unit.

**Text Books:**

1. Object Oriented Programming with C++ by E. Balagurusamy, McGraw-Hill Education (India)

2. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education

**Reference Books:**

1. Big C++ - Wiley India

2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)

3. C++ and Object Oriented Programming – Jana, PHI Learning.

4. Object Oriented Programming with C++ - Rajiv Sahay, Oxford

5. Mastering C++ - Venugopal, McGraw-Hill Education (India)

## CH20301: Fluid Flow & Flow Measurement Lab [0-2-0]

**Credit:** 01 **Teaching Scheme:** Laboratory 02 Hrs / Week

**Prerequisites**: Nil

**Objectives:** To acquaint the students with fundamentals of dynamic fluid flow and demonstrate the working details of various fluid flow measurement equipments and pumps.

**Course Details:**

**List of Practicals: (**Any 10**)**

**Experiment 1:** Fluidized Bed- To determine the minimum fluidization velocity and pressure drop.

**Experiment 2:** Flow through pipes- To find out the pressure drop.

**Experiment 3:** Centrifugal Pump - To draw the characteristics curve and find out the efficiency.

**Experiment 4:** Reciprocating Pump - To draw the characteristics curve and find out the efficiency.

**Experiment 5:** Venturimeter- To find out the flow rate of fluid inside a pipe.

**Experiment 6:** Orifice Meter- To find out the flow rate of fluid inside a pipe.

**Experiment 7:** Reynolds Apparatus – To verify the flow whether it is laminar or turbulent.

**Experiment 8:** Bernoulli's Apparatus – To verify the Bernoulli's Equation.

**Experiment 9:** Pitot tube – To find out the point velocity of fluid.

**Experiment 10:** V-Notch – To measure the flow rate of a fluid by using V–Notch.

**Experiment 11:** Packed Bed – To find out the pressure drop when a fluid is flowing through a packed bed.

**Text Book:**

T1. Unit Operations of Chemical Engineering, W. L. McCabe, W. L.Smith, and P. Harriot, McGraw-Hill International Edition, 6$^{th}$ ed., 2001.

**Reference Book:**

R1. Fluid Mechanics, Frank M. White, Tata McGraw-Hill, 6$^{th}$ Ed., New Delhi, 2008.

## CH20302: Chemical Technology Lab [0-2-0]

**Credit:** 01 **Teaching Scheme:** Laboratory 02 Hrs / Week

**Prerequisites**: Knowledge of intermediate level physical and organic chemistry

**Objectives:** To acquaint students with Industrial manufacturing processes at laboratory scale

**Course Details:**

**List of Practicals:**

**Experiment No. 1:** Manufacture of Soap from Vegetable Oil.

**Experiment No. 2:** Determination Dissolve Oxygen of the given Water Sample.

**Experiment No. 3:** Determination of pH value of the given slurry.

**Experiment No. 4:** To determine Acid value of the given Oil Sample.

**Experiment No. 5:** To determine concentration of Sugar solution by Refractometer.

**Experiment No. 6:** Estimation of $N_2$ in Nitrogenous fertilizer.

**Experiment No. 7:** Preparation of Jam & Jelly.

**Experiment No. 8:** Preparation of Natural Dyes.

**Experiment No. 9:** Preparation of sugar from sugar cane juice.

**Experiment No. 10:** Determination of sugar Content in a given fruit Sample.

**Text Books:**

T1. "Outlines of Chemical Technology", C.E. Dryden, Edited & revised by M. Gopal Rao & M. Sittig, Affiliated East-West Press, third Edition, 2010.

T2. "Shreeve's Chemical Process Industries", George T. Austin, McGraw Hill, 5th Edition, 2012.

**Reference Book:**

R1. "Organic Chemistry", Robert T Morrison, Robert N. Boyd, Prentice Hall, 6th Edition, 1992.

## CS21302: Object Oriented Programming using C++ Lab [0-2-0]

**Credit:** 01 **Teaching Scheme:** Laboratory 02 Hrs / Week

**Prerequisites**:

1. Basic C programming concepts.
2. Basic knowledge of various control statements.
3. Basic knowledge of function concepts and the idea of modularity.
4. Basic knowledge of Linux and Window Operating System.

**Objectives:**

1. To make the student learn an object oriented way of solving problems.
2. To teach the student to write programs in C++ to solve the problems.
3. To make the student to learn C++ programming language and its support for data

abstraction and data hiding.

4. Understanding different object oriented features.
5. Understanding advanced program flow and techniques.
6. Understanding pointers, references, pointers to member functions, memory management.
7. Understanding generic programming and exception hanling mechanisms.

**Course Details:**

1. Basic C++ programs, Input and output statements, C++ Programs to implement various control Structures.
2. Study of Function concept in C++.
3. Study of class and objects in C++.
4. Study of static members.
5. Study of friend function and friend class.
6. Study of various types of inheritance.
7. Study of static polymorphism with function overloading.
8. Study of static polymorphism with operator overloading.
9. Study of dynamic polymorphism with virtual functions.
10. Study of exception handling mechanism.
11. Study of generic programming using templates.

**List of Practicals:**

**Experiment No. 1:** Basic C++ programs, C++ Programs to Implement Various Control Structures.

a. If statement
b. Switch case statement and do while loop
c. For loop
d. While loop

**Experiment No. 2:** Programs to Understand Different Function Call Mechanism. Call by reference, Call by Value, Call by Address

a. Implementation of inline functions.
b. Implementation of Function with default arguments

**Experiment No. 3:** Program to understand class and object.

a. Program to differentiate between structure and class
b. Defining member functions inside and outside the class.

c. Program to implement array of objects.

d. Implementation of static data members and member functions.

**Experiment No. 4:** Programs to Understand Friend Function & Friend Class.

a. Friend Function

b. Friend class

**Experiment No. 5:** Program to implement constructors and destructors.

**Experiment No. 6:** Programs to Implement Inheritance

a.Single Inheritance(private and public mode derivation)

b. Multiple inheritances

c. Hierarchical inheritance

d. Multilevel Inheritance

e. Multipath Inheritance

**Experiment No. 7:** Understanding static Polymorphism

a. Program to implement function overloading and its ambiguity.

b. overloading unary operator as member and non member function.

c. Programs to Overload Binary Operators as member and non member function.

**Experiment No. 8:** Program to implement type conversion techniques.

a. basic to class type

b. class to basic type

c. one class type to another class type

**Experiment No. 9:** Program to implement dynamic polymorphism

a. Implementation of function overriding with virtual function

b. Use of this pointer

**Experiment No. 10:** a. Program to implement exception handling mechanism

b. Programs on Class Templates and Function Templates.

**Text Books:**

1. Object Oriented Programming with C++ by E. Balagurusamy, McGraw-Hill Education (India)

2. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education

**Reference Books:**

1. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)

2. Object Oriented Programming with C++ - Rajiv Sahay, Oxford

3. Mastering C++, Venugopal, McGraw-Hill Education (India)

## CH24301: Introduction to Process Automation [0-2-0]

**Credit:** 01 **Teaching Scheme:** Laboratory 02 Hrs / Week

**Prerequisites:** Basic ideas of engineering operations**.**

**Objectives:**

1. To get the basic idea of process automation and its need in present industrial scenario.
2. To introduce the various aspects of application of process automation in different chemical industries.
3. To improve the pronunciation, oral communication, expressions and the listening skills of the students.
4. To guide the students for their confidence in front of a group.

**Specific course scheme:**

1. Introduction to basic process automation.
2. Definition of automation.
3. Types of automation.
4. Need of automation.
5. Definition of chemical operation and process (Unit Operation & Unit Process).
6. Different chemical processes and application of automation in process industries.
7. The topic may be defined by the guide.
8. A report is required to submit before the presentation.
9. The presentation may be of minimum 15 minutes duration followed by 10 minutes of interaction.
10. All other nonparticipating students must attend each presentation and take part in the interactive sessions.

**Interactive sessions and presentation:**

1. Application of process automation in petrochemical and petroleum refinery engineering
2. Application of process automation in pharmaceutical industry
3. Application of process automation in paper and pulp Industry
4. Application of process automation in polymer, rubber, plastic industry
5. Application of process automation in metal and mineral process industries

6. Application of process automation cement, glass, ceramic industries.
7. Application of process automation in food, alcohol and beverages.

## CH27397: Mini Project [0-4-0]

**Credits:** 02 **Teaching Scheme:** 04 Hrs / week

For 3rd semester students a Mini Project is to be carried out considering the following objectives:

1. Scope for creativity
2. Hands on experience
3. Academic occupancy
4. Based on all the subjects in the continuing semester
5. The Mini Project group will be of 3 to 5 students.
6. Head of the Department will appoint Mini Project Guides. 02 credits will be awarded to the candidates after the viva voce and project demonstration at the end of the semester based on the project statement and requirements. The students are advised to utilize the laboratory resources before or after their contact hours as per the prescribed module.

## CH27401: Comprehensive Viva Voce [Oral]

**Credits:** 02

Compulsory for each student based on the two subjects (S2) CH20101 & (S3) CH20102.

End Semester Examination (Oral): 100 marks

- Mid-sem assessment: Viva-voce
- End semester assessment: Viva-voce

## HS27403: General Seminar on Communication Soft Skills [0-2-0]

**Credit:** 01 **Teaching Scheme:** Laboratory 2 Hrs / Week

**Prerequisites**: The students should have tolerable proficiency in different language skills. They should be able to understand and communicate an international language (English).

**Course Objectives**: This course seeks to develop the students' skill of preparing a seminar presentation and delivering it flawlessly.

**Course Outcomes:** Students will

**CO1**: understand the different stages involved in preparing and delivering a presentation

**CO2**: gain tolerable proficiency in communicating effectively in English.

**CO3**: be able to overcome their stage fright

**CO4**: be successful in making an effective seminar presentation

**Course details**

1. Lab-1: Importance and structure of Seminar Presentations
2. Lab-2: Types of Seminar Presentations
3. Lab-3: Good vs. Bad presentations and review of a standard seminar presentation
4. Lab-4: Changing formal seminar paper to informal seminar presentations
5. Lab-5: Planning: selection of topics and collection of data, laying down the objective and Preparing the outline
6. Lab-6: Preparing PPTs, referencing and other supporting materials
7. Lab-7: Handling Question Answer sessions and focusing on language of the Presentations
8. Lab-8: Voice modulation and delivery of the presentation
9. Lab-9: Group Presentation

10. Lab-10: Individual Presentation 1
11. Lab-11: Individual Presentation 2
12. Lab-12: Assessment and Rounding off

**Text Books**

T1. "English for Business Communication" by Sweeney, Simon, CUP, 2003.

T2. "Everyone Communicates, Few Connect" by John C. Maxwell, Thomas Nelson; 1 edition, 2010.