# Appendix "N" Item No.29

## B. Tech. CHEMICAL ENGINEERING

SCHEME AND SYLLABI (with effect from 2022-23)

B.Tech. (Chemical Engineering)

### I Year - I Semester

| Course code | Category | Course Title | Hours per week L | T | Internal Marks | External Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|
| CH-1101 | BS | Maths – I | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1102 | BS | Physics | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1103 | ES | Organic Chemistry | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1104 | ES | Mechanical Engineering | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1105 | ES | Basic Electrical Engineering | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1106 | ES | Organic Chemistry Lab. | 0 | 3 | 50 | 50 | 100 | 1.5 |
| CH-1107 | BS | Physics Lab | 0 | 3 | 50 | 50 | 100 | 1.5 |
| CH-1108 | ES | General Engineering Lab. (Mechanical Engineering & Electrical Engineering) | 0 | 3 | 50 | 50 | 100 | 1.5 |
| | | Total Credits | | | | | | 19.5 |

### I Year - II Semester

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CH-1201 | BS | Maths – II | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1202 | BS | Green Chemistry | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1203 | HSS | English | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1204 | ES | CPNM | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1205 | ES | Industry 4.0 | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-1206 | HSS | English Language Lab | 0 | 3 | 50 | 50 | 100 | 1.5 |
| CH-1207 | BS | Green Chemistry Lab | 0 | 3 | 50 | 50 | 100 | 1.5 |
| CH-1208 | ES | CPNM Lab | 0 | 3 | 50 | 50 | 100 | 1.5 |
| | | Total Credits | | | | | | 19.5 |

### II Year - I Semester

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CH-2101 | BS | Maths-III | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2102 | PC | Fluid Mechanics | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2103 | PC | Particle and Fluid Particle Processing | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2104 | PC | Heat Transfer | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2105 | HSS | Managerial Economics | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2106 | PC | Fluid Mechanics LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| CH-2107 | PC | Particle and Fluid Particle Processing LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| CH-2108 | PC | Heat Transfer LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| CH-2109 | SC | *MATLAB (software training)* | 1 | 2 | 50 | 50 | 100 | 2 |
| CH-2110 | MC | Professional Ethics & Universal Human values | 0 | 0 | - | 100 | 100 | 0 |
| CH-2111 | MC | NCC/NSS | 0 | 2 | - | - | - | 0 |
| | | Total Credits | | | | | | 21.5 |

### II Year - II Semester

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CH-2201 | ES | Material Science & Engineering | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2202 | BS | Python Programming | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2203 | PC | Material and Energy Balances | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2204 | PC | Chemical Engineering Thermodynamics | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2205 | PC | General Chemical Technology | 4 | 0 | 30 | 70 | 100 | 3 |
| CH-2206 | PC | Python Programming LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| CH-2207 | PC | General Chemical Technology LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| CH-2208 | SC | Computer Aided Machine Drawing | 1 | 2 | 50 | 50 | 100 | 2 |
| CH-2209 | MC | Environmental Science | 0 | 0 | - | 100 | 100 | 0 |
| | | Total Credits | | | | | | 20 |

Internship – I

## CH-1101 MATHEMATICS-I

**Course Objectives:**

* To transmit the knowledge of Partial differentiation.

* To know of getting maxima and minima of function of two variables and finding errors and approximations.

* To evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

**Course Outcomes:**

* Find the partial derivatives of functions of two or more variables.

* Evaluate maxima and minima, errors and approximations.

* Evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

* Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

## SYLLABUS

**Partial Differentiation:** Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobins. Mean value Theorems (without proofs).

**Applications of Partial Differentiation:** Geometrical interpretation - Tangent plane and Normal to a surface -Taylor's theorem for functions of two variables - Errors and approximations -Total differential. Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz's rule.

**Multiple Integrals :** Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

**Multiple Integrals-Applications:** Area enclosed by plane curves - Volumes of solids - Area of a curved surface - Calculation of Mass - Center of gravity - Moment of inertia - product of inertia – principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions. Error Function or Probability Integral.

**Fourier Series:** Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula. Practical Harmonic analysis.

Text Book:

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd Edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K.International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

6. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

## CH-1102 PHYSICS

**Course Objectives:**

* To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.

* To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultrasonics and their applications in engineering.

* To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.

* To Learn basics of lasers and optical fibers and their use in some applications.

* To Understand concepts and principles in quantum mechanics and Nanopahse Materials. Relate them to some applications.

**Course Outcomes:**

* Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.

* Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications .

* Understand the Theory of Superposition of waves. Understand the formation of Newton's rings and the working of Michelson's interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due to a single slit

* Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fiber communication.

* Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one Dimensional Schrodinger's wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

## SYLLABUS

Thermodynamics : Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

Electromagnetism : **C**oncept of electric flux, Gauss's law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

**Ultrasonics :** Introduction, Production of Ultrasonics – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultrasonics.

**Optics**

**Interference:** Principles of superposition – Young's Experiment – Coherence - Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications.

**Diffraction:** Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit (Qualitative and quantitative treatment).

**Polarisation:** Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

**Lasers and Fibre Optics:** Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers

Introduction to optical fibers, principle of propagation of light in optical fibers, Acceptance Angle and cone of a fibre, Numerical aperture, Modes of propagations, classification of fibers, Fibre optics in communications, Application of optical fibers.

**Modern Physics: I**ntroduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi conductors and insulators.

**Nanophase Materials :** Introduction, properties, Top-down and bottom up approaches, Synthesis - Ball milling, Chemical vapour deposition method , sol-gel methods, Applications of nano materials.

Text Books :

1. Physics by David Halliday and Robert Resnick – Part I and Part II **-** Wiley.

2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand

3. Engineering Physics by R.K. Gaur and S.L. Gupta –Dhanpat Rai

Reference Books:

1. Modern Engineering Physics by A.S. Vadudeva

2. University Physics by Young and Freedman

## CH-1103 : ORGANIC CHEMISTRY

**Course Objectives:**

The student will be able to:

* appreciate the nature and scope of organic chemistry.

* apply key concepts from general chemistry including electronegativity, bonding (ionic and covalent), hybridization of atomic orbitals, and molecular orbital theory to organic systems.

* draw skeletal structures for organic compounds.

* apply acid-base concepts to organic systems; predict ordering of acid or base strength.

* name alkanes, alkenes, polyenes, alkynes, alkyl halides, aromatic compounds, carbonyl compounds, amines and their various derivatives using systematic (IUPAC) nomenclature.

* draw reaction mechanisms for some key reactions.

* recognize stereochemistry and be able to apply the Cahn-Ingold-Prelog system to designation of stereochemistry (E/Z or R/S).

* learn many of the reactions of alkanes, alkenes, polyenes, alkynes, aromatic, carbonyl, and amine compounds, and close related species. Be able to predict reactions involving these functional groups.

* be able to solve problems employing spectroscopic methods including mass spectrometry, infrared and NMR spectroscopy.

* understand the basic chemical and structural features of biomolecules, including lipids, carbohydrates, amino acids and proteins, and nucleic acids.

**Course Outcomes:**

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

* Determine the molecular formula for organic compounds

* Differentiate the structure and properties of biomolecules, polymers and heterocyclic compounds

* Identify the role of chemical engineer in modern drug discovery programs

* Separate the racemic mixtures using resolution methods

* Elucidate the structure of organic compounds (small molecules) using spectroscopic methods.

### SYLLABUS

**Numerical Problems:** Determination of percentage composition of carbon, hydrogen and nitrogen, molecular weight determination by depression in freezing point and elevation of boiling point methods, molecular weight of acids by silver salt method; molecular weight of bases by chloroplatinate method, determination of molecular formula of a compound, problems relating to reactions of carboxylic acids, functional derivatives of acids, carbonyl compounds, alcohols, amines, phenols, diazonium salts applications, alkenes and their laboratory tests,

Nomenclature of alkanes, alkenes, alkynes, dienes, cyclic aliphatic hydrocarbons, structure of benzene, nomenclature of benzene derivatives,

arenas, industrial preparation of ethylene, acetylene; sp, $sp^2$ and $sp^3$ hybridization; preparation and chemical reactions; conformational analysis of ethane, propane and butane, W urtz reaction, Diels-Alder reaction, aromaticityMorkovinkov rule, Clemmensen and Wulf-Kishner reduction,

**Electro-philic and Nucleo-philic Aromatic Substitution:** Orientation in desubstituted benzenes, mechanism of nitration, halogenation, sulphonation, Friedel-Craft's alkylation and acylation reactions, nomenclature of alkyl halides, preparation and chemical reactions, mechanisms of $SN_1$, $SN_2$, $E_1$, $E_2$ reactions, nomenclature of aryl halides, preparation and chemical reactions: low reactivity of vinyl and aryl halides, Sandmeyer reaction,

**Nomenclature of Alcohols;** industrial preparation of ethyl alcohol, preparation and chemical reactions, Lucas test, nomenclature of mono, dicarboxylic acids, industrial preparation of formic, acetic, benzoic, phthalic, salicylic acids, preparation and chemical reactions, mechanism of HVZ reaction and Claisen condensation, nomenclature of functional derivatives of acids, preparation and chemical reactions, mechanism of Hoffmann bromamide reaction, acid and base catalyzed hydrolysis of ester, nomenclature of ethers and epoxides, industrial preparation of ether and ethylene oxide, preparation and chemical reactions; Williamson's synthesis,

**Nomenclature of Aldehydes and Ketenes:** Industrial preparation of formaldehyde, acetaldehyde, benzaldehyde, salicyaldehyde, acetone; preparation and chemical reactions; mechanisms of Cannizaro, Aldol, Reformatsky and Wittig reactions, reactions without mechanisms -Perkin, Cope, Knoevenagel and Pinacol-Pinacolone reactions, difference between aldehyde and ketone, nomenclature of phenols, industrial preparation of phenol, preparation and chemical reactions, mechanisms of Fries rearrangement, Kobe reaction, Reimer-Tiemann reaction, classification of carbohydrates, structure of glucose and fructose, reactions of glucose and fructose, Ruff degradation, Wohls degradation, filiani-Fisher synthesis, glucose into fructose, fructose into glucose, glucose to vitamin-C, mechanism of Osazone formation,

Nomenclature of amines, industrial preparation of aniline, preparation and chemical reactions - exhaustive methylation, mechanism of Hoffmann elimination, benzedene rearrangement without mechanism, Hinsberg test, differentiation test using nitrous acid, preparation of diazonium salts and synthetic applications, preparation of sulphanilamide, sulphaguanidine, sulphamerazine, sulphapyridene (sulpha drugs), mode of action of sulpha drugs,

**Preparation of Soaps and Detergents:** Mode of action of soaps, differences between soaps and detergents; preparation of malonic, acetoacetic ester and their synthetic applications, preparation of Grignard reagents and their synthetic applications, preparation of polyethylene, polystyrene, teflon, PVC, polyvinyl cyanide, rubber-vulcanisation, styrene-butadiene rubber, polychloroprene, bakelite, nylon-6 and nylon 6-6, plexiglas, terylene, Ziegler-Natta polymerization, definition of thermoplastics and thermosetting plastics,

Isomerism**:** Structural and optical isomerism, geometrical isomerism, E Z configuration, sequence rules, R & S configuration, racemic mixture and their separation, asymmetric synthesis - Fischer projection formula, definitions of axial and equatorial bonds, 1-3- diaxial interaction, enatiomers, diastereomers, mesomers, isomerism in cyclic compounds, chair, boat and twisted boat structures (1-methylcyclohexane, 1, 2-cyclohexane diol), sSynthetic applications of - Zn/Hg, Na-$NH_3$$LiAH_4$, $NaBH_4$, diborane and zinc dust, soda lime, $OsO_4$, hydroxylamine, acetic anhydride, benzoylchloride and $PCl_5$.

Reference Books:


1. 'Text Book of Organic Chemistry' by Morrison & Boyd
2. 'Text Book of Organic Chemistry' by Bahl&Tuli
3. 'Text Book of Organic Chemistry' by M.K.Jain
4. 'Text Book of Organic Chemistry' by I.L.Finar (Vols.1&2 as reference books)


## CH-1104 : MECHANICAL ENGINEERING

**Course Objectives:**

* To be aware of the basics in Thermodynamics
* To get knowledge on applications of steam tables
* To understand the principles and applications of IC engines, compressors and turbines
* To comprehend the principles of belts, chain drives and gears

**Course Outcomes:**

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

* To Know the thermodynamic laws and various processes
* To make out the applications of steam in boilers and turbines
* To derive the various performance parameters related to IC engines and of air compressors
* To arrive basic needs of working of belts, chain drives and gears

## SYLLABUS

**Thermodynamics:** Definitions, systems, classification of thermodynamic systems, cycles and zeroth law of thermodynamics, first law of thermodynamics, closed system, flow processes, open systems with steady flow process, applications of steady flow energy equation to engineering systems.

**Second Law of Thermodynamics:** Carnot cycle, inequality of Classius-reversible Carnot cycle, entropy, relation between heat and entropy, general

expression for entropy change, entropy change of a perfect gas during various thermodynamic processes, air standard cycles, Otto, diesel, dual combustion cycles.

**Properties of Steam and Use of Steam Tables:** Boilers, classification steam boilers, simple vertical, Cochran, locomotive boiler, Babcock and Wilcox boiler, steam generation, Rankine cycle.

**Impulse and Reaction Turbine:** Classification of steam turbines, velocity diagram and power produced in impulse turbine, performance of steam turbines, reduction of rotor speed, I C engines: Classification-main composition of IC engines, carburettor, fuel pump injector, cooling systems for IC engines, working of 2-stroke and 4-stroke petrol and diesel engines, power and efficiency of IC engines.

**Reciprocating Air-Compressors:** Single stage, work done during cycle, effect of clearance, two stage compressors, condition for minimum work, effect of inter-cooling, efficiency.

**Drives:** Belts, expression for the ratios of tension on the slack and tight side, power transmitted – V-belts, chain drives, gears – spur, helical, bevel gear, trains simple and compound.

Text Books:

1. A Text Book of Thermal Engineering by R.S.Khurmi and J.K.Gupta
2. 'Theory of Machines' by R.S.Khurmi

Reference Books:

1. 'Engineering Thermodynamics' by P.K.Nag
2. 'Engineering Thermodynamics' by J.B.Jones and R.E.Dugar
3. 'Engineering Thermodynamics' by R.K.Rajput
4. 'Theory of Machines' by Balani

## CH-1105 : BASIC ELECTRICAL ENGINEERING

**Course Objectives:**

* An understanding of basic EE abstractions depends on analysis and design of electric and magnetic circuits and its elements.

* To provide the students with knowledge of fundamental laws in electrical engineering

* To develop the ability of the students to analyze electrical and magnetic circuits using the basic laws of electrical engineering

* To expose the students to the concepts of various types of electrical machines and application of electrical machines.

* To inculcate the understanding about the AC fundamentals

* To prepare the students to have a basic knowledge of transformers

* To acknowledge about three phase induction motor and its operating principle

* To know about the fundamentals of synchronous motors and its working principle

**Course Outcomes:**

After the completion of the course, the student should be able

* To predict the behavior of any electrical and magnetic circuits.

* student will be able to state and explain the basic laws of electromagnetic induction.

* To impart knowledge on Constructional details, principle of operation, types of Electrical Machines performance Characteristics ,speed control methods and its applications

* Ability to conduct experiments on Ac Machines to find its characteristics.

* Abel to calculate performance characteristics of transformer like regulation and efficiency

* The ability to formulate and then analyze the working of synchronous motors

* Able to solve simple problems on synchronous motors

### SYLLABUS

**Magnetic Circuits:** Definitions of magnetic circuit, reluctance, magneto motive force (mmf), magnetic flux, simple problems on magnetic circuits, hysterisis loss (chapter 8, page nos. 155-175),

**Electromagnetic Induction:** Faraday's laws of electromagnetic induction, induced E.M.F., dynamically induced E.M.F, statistically induced EMF, self inductance, mutual inductance (Chapter 9, page nos. 176-190),

**D.C. Generators:** D.C generator principle, construction of D.C generator, E.M.F equation of D.C generator, types of D.C generators, armature reaction, losses in D.C generator, efficiency, characteristics of D.C generators, applications of D.C generators (chapter 10, 11, pages 208-238),

**D.C. Motors:** D.C motor principle, working of D.C motors, significance of back, E.M.F, torque equation of D.C motors, types of D.C motors, characteristics of D.C motors, speed control methods of D.C motors, applications of D.C motor, testing of D.C machines, losses and efficiency, direct load test and Swinburne's test (Chapter 12, 13, page Nos. 239-269),

**A.C. Circuits:** Introduction to steady state analysis of A.C circuits, single and balanced 3 phase circuits (chapter 16, page nos. 323-348),

**Transformers:** Transformer principle, EMF-equation of transformer, transformer on load, equivalent circuit of transformer, voltage regulation of transformer, losses in a transformer, calculation of efficiency and regulation

by open circuit and short circuit tests (Chapter 20, page Nos. 423-455),

**Three Phase Inductance Motor:** Induction motor working principle, construction of 3-phase induction motor, principle of operation, types of 3-phase induction motor, torque equation of induction motor, slip-torque characteristics, starting torque, torque under running condition, maximum torque equation, power stages of induction motor, efficiency calculation of induction motor by direct loading (Chapter 21, page nos. 463-489),

**Altemator:** Altenator working principle, EMF equation of altenator, voltage regulation by Synchronised impedance method (Chapter 23, page nos. 505-515),

Synchonous motor: Synchronous motor principle of operation, construction, methods of starting of synchronous motor, (Chapter- 24, page nos. 516-526),

Text Book:

'Elements of Electrical Engineering & Electronics' by V.K. Mehta, S.Chand & Co.

Reference Book:

'A first course in Electrical Engineering' by Kothari.

## CH-1106 : ORGANIC CHEMISTRY LABORATORY

**Course Objectives:**

* The student will learn to analyze the organic compounds. The students will be exposed to the preparation of various organic chemicals in this laboratory.

**Course Outcomes:**

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

* Analyze and identify the given organic compound

* Prepare organic compounds like aspirin, benzanilide, m-dinitrobenzene, benzoic acid, phthalimide, methyl orange, parabenzoquinone and nerolin

* Identify extra elements

**List of Experiments:**

1. Preparation of aspirin
2. Preparation of benzanilide
3. Preparation of m-dinitrobenzene
4. Preparation of benzoic acid
5. Preparation of phthalimide
6. Preparation of methyl orange
7. Preparation of parabenzoquinone
8. Preparation of nerolin
9. Detection of extra elements
10. Analysis of compound -1
11. Analysis of compound -2
12. Analysis of compound -3
13. Analysis of compound -4
14. Analysis of compound -5
15. Analysis of compound -6

## CH-1107 : PHYSICS LAB

**Course Objectives:**

* To enable the students to acquire skill, technique and utilization of the Instruments

* Draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.

* To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.

* To familiarize the handling of basic physical apparatus like Vernier callipers, screw gauge, spectrometers, travelling microscope, laser device, optical fibre, etc.

**Course Outcomes:**

* Ability to design and conduct experiments as well as to analyze and interpret

* Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics

* The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

### SYLLABUS

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton's Rings.
2. Determination of Wavelength of Spectral Lines in the Mercury Spectrum by Normal Incidence method.
3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.
4. Determination of Cauchy's Constants of a Given Material of the Prism using Spectrometer.

5. Determination of Refractive Index of Ordinary ray $m_o$ and Extraordinary $m_e$ ray.

6. Determination of Thickness Given Paper Strip by Wedge Method.

7. Calibration of Low Range Voltmeter.

8. Calibration of Low Range Ammeter.

9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.

10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.

11. Carey Foster's Bridge – Verification of laws of Resistance and Determination of Specific Resistance.

12. Melde's Apparatus – Frequency of electrically maintained Tuning Fork.

13. Photoelectric cell-Characteristics.

14. Planks Constants.

15. Laser- Diffraction.

## CH-1108 : GENERAL ENGINEERING LABORATORY

### MECHANICAL ENGINEERING LABORATORY

**Course Objectives:**

* To be aware of the viscosity, flash point of oil samples and calorific value of a gas

* To get knowledge on calibration of pressure gauge, flywheel and torsional pendulum

* To understand the principles and applications of Air compressors and IC engines

**Course Outcomes:**

* To determine the viscosity, flash point and calorific value of fluids

* To make out the applications of pressure gauge, flywheel and torsional pendulum

* To derive performance parameters related to IC engines and efficiencies of air compressor

**Experiments:**

1. Find the viscosity of the given sample of oil using Redwood viscometer-1

2. Find the viscosity of the given sample of oil using Redwood viscometer-II

3. Find the flash point of the given sample of oil using Abel's flash point tester

4. To calibrate pressure gauge using standard pressure and standard weights

5. Draw the valve timing diagram of a 4-stroke diesel engine and port timing diagram of a 2-stroke petrol engine

6. Perform load test at full load, half load, ¼ th load on a 4-stroke Ruston engine and draw the performance curves

7. Find the volumetric efficiency, isothermal efficiency of the given compressor

8. To determine the moment of inertia of a fly-wheel and shaft experimentally and compare the values with the calculated values

9. To determine experimentally the calorific value of a gaseous fuel by using Junkers gas calorimeter

10. To determine the modulus of rigidity of the material of the wire by torsional oscillators

### ELECTRICAL ENGINEERING LABORATORY

**Course Objectives :** This course provides

* Insight of fundamental laws in electrical engineering.

* Deals with the constructional and operational details of DC and AC machines.

* Analyze electrical and magnetic circuits using basic laws of electrical engineering

**Course Outcomes:**

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

* Understand the basic laws of electrical and magnetic circuits.

* Analyze the characteristics of DC generator and motors.

* Design of equivalent circuit of transformer.

* Apply the basic knowledge to solve problems on synchronous machines.

**Experiments:**

1. Study and calibration of ammeter
2. Study and calibration of voltmeter
3. Study and calibration of wattmeter
4. Study and calibration of energy meter
5. Measurement of low resistance (armature)
6. Measurement of medium resistance (field)
7. Measurement of insulation resistance
8. Measurement of filament resistance

9. Verification of KCL and KVC
10. Superposition theorem.
11. Parameters of a choke coil
12. OC and SC tests on transformer
13. Load test D.C. shunt machine
14. OC test on DC,. separately excited machine
15. Swinburne's test
16. 3-phase induction motor (No load and rotor block tests)
17. Alternator regulation by Syn. impedance method

## CH-1201 : MATHEMATICS – II

**Course Objectives:**

* The way of obtaining rank, eigen values and eigen vectors of a matrix.

* To know the importance of Cayley-Hamilton theorem and getting canonical form from a given quadratic form.

* To solve the system of equations by using direct and indirect methods.

* To solve first order and higher order differential equations by various methods.

* To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

**Course Outcomes:**

* Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.

* Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.

* Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling

* Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.

* Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

## SYLLABUS

**Linear Algebra:** Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination method, LU Factorization method, Gauss Seidal Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

**Eigen Values and Eigen Vectors :** Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

**Ordinary Differential Equations of First Order and its Applications:** Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations - Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton's Law of Cooling - Law of Natural growth and decay.

**Differential Equations of Higher Order:** Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear differential equations.

**Laplace Transforms :** Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by $t^n$ - Division by t – Evaluation of integrals by Laplace Transforms - Inverse Laplace Transform - Applications of Laplace Transforms to Ordinary Differential Equations - Simultaneous Linear Differential Equations with Constant Coefficients - Second Shifting Theorem - Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

Text Book:

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

## CH-1202 : GREEN CHEMISTRY

## SYLLABUS

**Course Objectives:**

CO 1: To apply the basic knowledge of Chemistry to the Engineering Discipline.

CO 2: To develop knowledge about water and its treatment for industrial and potable purposes.

CO 3: To develop understanding in the areas of Batteries, Fuels Mechanism of Corrosion of Metals and Corrosion Control Methods, Green Chemistry and Technology and Processes involving Green Chemistry and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

**Learning outcome:**

LO 1: The students are able to apply the basic concepts and principles studied in Chemistry to the field of Engineering.

LO 2: The students are able to apply chemistry to different branches of engineering

LO 3: The students are able to acquire the knowledge in the areas of Water Chemistry, Mechanism of Corrosion of Metals and Corrosion Control Methods, Batteries, Fuel Cells, Green Chemistry and Technology and Processes involving Green Chemistry and suggest innovative solutions for existing challenges in these areas.

Unit 1: Water Technology : Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Unit 2: Batteries : Primary batteries: The chemistry - Types: Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells – liquid cathode, solid cathode and lithium-ferrous sulphide cells. Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells. Advanced Batteries for electric vehicles, requirements of the battery – sodium-beta and redox batteries.

Unit 3: Fuel Cells : Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells- Membranes and Fuels

Unit 4: Corrosion : **Corrosion:** Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting, Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion. Corrosion Controlling Methods, Protective Coatings, Metallic Coatings, Electroplating and Electroless Plating.

Unit 5: Green Chemistry and Technology : Introduction and significance of green chemistry, Goals of green chemistry, 12 principles of green chemistry, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, functional group approaches to green chemistry, Elimination of toxic functional group, optimization of frameworks for the design of greener synthetic pathways, Applications of green chemistry - Green solvents, green fuels and propellants, biocatalysis.

Text Books

1. Engineering Chemistry – PC Jain and M. Jain – Dhanpath Rai and Sons, New Delhi.

2. A Text book of Engineering Chemistry – S. S. Dara – S. Chand & Co. New Delhi.

3. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.

## CH-1203 ENGLISH

**Course Objectives:**

* To make students understand the explicit and implicit meanings of a text/topic;

* To give exposure to new words and phrases, and aid to use them in different contexts;

* To apply relevant writing formats to draft essays, letters, emails and presentations; and

* To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

**Course Outcomes:**

* Students will be able to analyse a given text and discover the various aspects related to language and literature;

* Learn the various language structures, parts of speech and figures of speech;

* Develop one's reading and writing abilities for enhanced communication; and

* Learn to apply the topics in real-life situations for creative and critical use.

## SYLLABUS

On the conduct of life: William Hazlitt

Life skills: Values and Ethics

If: Rudyard Kipling

The Brook: Alfred Tennyson

Life skills: Self-Improvement

How I Became a Public Speaker: George Bernard Shaw

The Death Trap: Saki

Life skills: Time Management

On saving Time: Seneca

Chindu Yellama

Life skills: Innovation

Muhammad Yunus

Politics and the English Language: George Orwell

Life skills: Motivation

Dancer with a White Parasol: Ranjana Dave

Grammar: Prepositions – Articles – Noun-Pronoun Agreement, Subject-Verb Agreement – Misplaced Modifiers – Clichés, Redundancies.

Vocabulary: Introduction to Word Formation – Root Words from other Languages – Prefixes and Suffixes – Synonyms, Antonyms – Common Abbreviations

Writing: Clauses and Sentences – Punctuation – Principals of Good Writing – Essay Writing – Writing a Summary

**Writing:** Essay Writing

Life skills: Innovation

Muhammad Yunus

Text Book:

Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India. 2018.

References Books:


1. Practical English Usage, Michael Swan. OUP. 1995.
2. Remedial English Grammar, F.T. Wood. Macmillan.2007
3. On Writing Well, William Zinsser. Harper Resource Book. 2001
4. Study Writing, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills, Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.


## CH-1204 : 'C'-Programing and Numerical Methods

**Course Objectives:**

* The course is designed to provide complete knowledge of C language.

* To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

* To provide knowledge to the Students to develop logics which will help them to create programs, applications in C.

* This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

* This course provides the fundamental knowledge which is useful in understanding the other programming languages.

**Course Outcomes:**

* Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and Apply them in problem solving.

* Apply various operations on derived data types like arrays and strings in problem solving.

* Design and Implement of modular Programming and memory management using Functions, pointers.

* Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.

* Apply Numerical methods to Solve the complex Engineering problems.

## SYLLABUS

**Introduction to C:** Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

**Decision Making, Branching, Looping, Arrays & Strings:** Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else..if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops ,One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

**Functions:** Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

**Pointers:** Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications

**Structure and Unions:** Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

**File Handling:** Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments- Program Applications

**Numerical Methods:** Solutions of Algebraic and Transcendental Equations, Bisection Method, Newton Raphson Method. Newton's forward and backward Interpolation, Lagrange's Interpolation in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules. Solutions of Ordinary First Order Differential Equations: Euler's Method, Modified Euler's Method and Runge-Kutta Method.

Text Books:

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India) Private Limited.

2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

Reference Books:

1. Let Us C ,YashwantKanetkar, BPB Publications, 5th Edition.

2. Computer Science, A structured programming approach using C", B.A.Forouzan and R.F.Gilberg, " 3rd Edition, Thomson, 2007.

3. The C –Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.

4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Enzo Marinari (Author), Giovanni Organtini, World Scientific.

## CH-1205 : INDUSTRY 4.0

## SYLLABUS

Unit-1: Introduction to Industry 4.0 : Introduction, Idea of Industry 4.0, Various Industrial Revolutions, Origin concept of Industry 4.0,Industry 4.0 Production system, How is India preparing for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory.

Unit-2: Trends in Industry 4.0 : Introduction, Main Concepts and Components of Industry 4.0, State of Art Technologies, Proposed Framework for Industry 4.0, Trends of Industrial Big Data and Smart Business Transformation.

Unit-3: Roadmap for Industry 4.0 : Introduction, Proposed Framework for Technology Roadmap: Strategy Phase, Development Phase, Smart Manufacturing, Types of Smart Devices, Smart Logistics, Smart Cities, Predictive Analytics.

Unit-4: Advances in the Era of Industry 4.0 : Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Things, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly, IIoT- Industrial IoT.

Unit-5: The Role of Industry 4.0 and Future Aspects : Introduction, Challenges & Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

**(MATERIAL IS READILY AVAILABLE ON INTERNET)**

## CH-1206 : ENGLISH LANGUAGE LAB

**Course Objectives:**

* To make students recognize the sounds of English through Audio-Visual aids;

* To help students build their confidence and help them to overcome their inhibitions and self- consciousness while speaking in English;

* To familiarize the students with stress and intonation and enable them to speak English effectively; and

* To give learners exposure to and practice in speaking in both formal and informal contexts.

**Course Outcomes:**

* Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;

* A study of the communicative items in the laboratory will help students become successful in the competitive world;

* Students will be able to participate in group activities like roleplays, group discussions and debates; and

* Students will be able to express themselves fluently and accurately in social as well professional context.

## SYLLABUS

**Introduction to Phonetics:** The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

**Listening Skills:** Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

**Speaking Skills**: Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

**Reading and Writing Skills:** Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

**Presentation Skills**: Verbal and non-verbal communication - Body Language - Making a Presentation.

Reference Books:

1. Ashraf Rizvi. Effective Technical Communication. Tata McGraw Hill Education Private Limited, New Delhi.

2. Speak Well. Orient Blackswan Publishers, Hyderabad.

3. Allan Pease. Body Language. Manjul Publishing House, New Delhi.

## CH-1207 : GREEN CHEMISTRY LAB

**Course Objectives:**

CO 1:To develop the fine skills of quantitative determination of various chemical components through titrimetric analysis
CO 2:To prepare ion exchange/ zeolite column for removal of hardness
CO 3:To develop the skill of green synthesis through the preparation of a polymer/ drug

**Learning Outcomes:**

LO 1: The students are able to determine the amount of various chemical species in solutions by titrations quantitatively with accuracy
LO 2: The students are able to develop novel materials to be used as zeolite and prepare columns for removal of hardness of water
LO 3: The students develop skills to synthesise a polymer or a drug

## SYLLABUS

1. Determination of Sodium Hydroxide with HCl ($Na_2CO_3$ Primary Standard)

2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample

3. Determination of percentage of Iron in the given rust solution by external indicator method

4. Determination of total Hardness of Water sample by EDTA method

5. Preparation and analysis of Ionexchange/ Zeolite column for removal of hardness of water

6. Green Synthesis of Polymer/ drug

Reference Books:

1. Vogel's Quantitative Chemical Analysis – V – Edition – Longman.

2. Experiments in Applied Chemistry (For Engineering Students) – Sinita Rattan – S. K. Kataria & Sons, New Delhi

## CH-1208 : CPNM LAB

**Course Objectives:**

* To impart writing skill of C programming to the students and solving problems.

* To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,

* To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.

* This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

**Course Outcomes:**

* Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.

* Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.

* Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.

* Apply and practice logical ability to solve the real world problems.

* Apply Numerical methods to Solve the complex Engineering problems.

## SYLLABUS

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?

2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while).

3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position, Copying one string to another, Reversing a string, adding one string to another.

4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?

5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.

6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).

7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.

8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.

9. Implement bisection method to find the square root of a given number to a given accuracy.

10. Implement Newton Raphson method to det. a root of polynomial equation.

11. Given table of x and corresponding f(x) values, Write a program which will determine f(x) value at an intermediate x value by using Lagrange's interpolation/

12. Write a function which will invert a matrix.

13. Implement Simpson's rule for numerical integration.

14. Write a program to solve a set of linear algebra.

## CH-2101 : MATHEMATICS-III

**Course Objectives:**

The objectives, in particular are to learn about:

* Differentiation of vector functions of real variables, curves in space, differential operators, the concept of gradient, divergence and curl and their potential applications.

* The concepts of Line-, Surface and Volume integrals and transformation theorems such as Green's theorem in the plane, Stoke's theorem, Gauss Divergence theorem and their applications.

* Formation of Partial Differential Equations and solution of first order first degree linear, non-linear Partial Differential Equations, Homogeneous and Non homogeneous linear partial differential equations with constant coefficients.

* The method of separation of variables and how to use it to find the solution of one dimensional wave (string equation), one-and two-dimensional Heat flow equations, Laplace's equation in Cartesian and polar coordinates.

* The concept of integral transforms, namely, Fourier transforms, Fourier Sine, Cosine and related inversetransforms, and their applications in solving several Physical and Engineering problems.

**Course Outcomes:**

At the end of the course, the students would be able to:

* Understand differential operations and the concepts of Gradient, Divergence and Curl and their applications.

* Apply the concepts of Line integrals, Surface Integrals, Volume Integrals and their potential applications: work done by a force field, circulation and Flux etc. Also, find out the relation between Line, Surface and Volume integrals: Green's theorem in the plane, Stoke's and Divergence theorems.

* Understand the formation of partial differential equations and the solving Linear and Non linear first order partial differential equations. Also, how to find the solution of Linear Partial Differential Equations with constant coefficients by finding the complementary function and particular integrals.

* Apply the method of separation of variables to solve the important governing equations of one dimensional wave equation, One and Two dimensional heat flow equations, Laplace's equations in Cartesian and polar coordinates.

* Apply the knowledge of Fourier transform techniques in solving several Initial and Boundary value problems of Engineering, such as problems in Conduction of heat **/** Thermodynamics, Hydraulics transverse vibrations of a string, oscillations of an elastic beam, bending of beams, electrical circuits, free and forced vibrations of a membrane and transmission lines , etc.

## SYLLABUS

**Vector Calculus-Differentiation:** Differentiation of vectors, curves in space, velocity and acceleration, relative velocity and relative acceleration, scalar and vector point functions, vector operator Ñ applied to scalar point functions- gradient, Ñ applied to vector point functions- divergence and curl. Physical interpretation of gradient, divergence and culrl (i.e., $\nabla f$, $\nabla.\overline{F}$, $\nabla \times \overline{F}$), Irrotational and Solenoidal fields, the relations obtained after Ñ applied twice to point functions, Ñ applied to products of two functions.

**Vector Integration:** Integration of vectors, line integral, circulation, work done, surface integral-flux, Green's theorem in the plane, Stoke's theorem, volume integral, Gauss Divergence theorem. (All theorems without proofs) Introduction of orthogonal curvilinear coordinates, cylindrical and spherical polar coordinates

**Partial Differential Equations:** Formation of partial differential equations, solutions of partial differential equations- equations solvable by direct integration, linear equations of first order: Lagrange's Linear equation, non-linear equations of first order, Charpit's method. Homogeneous linear equations with constant coefficients- rules for finding the complementary function, rules for finding the particular integral (working procedure), non-homogeneous linear equations.

**Applications Of Partial Differential Equations:** Method of separation of variables, One dimensional wave equation-vibrations of a stretched string, one dimensional Heat flow equation, Two dimensional heat flow in steady state - solution of Laplace's equation in Cartesian and polar coordinates (two dimensional).

**Integral Transforms (Fourier Transform):** Introduction, definition, Fourier integral, Sine and Cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier Sine and Cosine transforms, Finite Fourier Sine and Cosine transforms, properties of Fourier transforms.

Convolution theorem for Fourier transforms, Parseval's identity for Fourier transforms, Fourier transforms of the derivatives of a function, simple applications to Boundary value problems.

Text Book:

Scope and treatment as in "Higher Engineering Mathematics", by Dr. B.S.Grewal, 43rd Edition, Khanna Publishers.

Reference Books:


1. Graduate Engineering Mathematics by V B Kumar Vatti, I.K.International publications
2. Advanced Engineering Mathematics by Erwin Kreyszig.
3. A text book of Engineering Mathematics by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.
4. Mathematical Methods of Science & Engineering aided with MATLAB by Kanti B.Dutta, Cengage Learning India Pvt. Ltd.
5. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw Hill Company.
6. Advanced Engineering Mathematics by H.K.Dass. S.Chand Company.


## CH-2102 : FLUID MECHANICS

**Course Objectives:**

To provide

* Knowledge on pressure distribution in static fluids.
* Knowledge on rheological behavior of fluids, types of fluid flow, boundary layers and basic equations of fluid flow.
* Knowledge of incompressible & compressible fluid flow in pipes
* Knowledge on fluid flowing past solid surfaces
* Knowledge on pipes, fittings, transportation and metering devices.

**Course Outcomes:**

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

* Derive dimensionless groups by using dimensional analysis.
* Solve problems related to manometers and decanters using the principles of fluid statics.
* Determine the pipe size / flow rate / power requirements under laminar and turbulent flow conditions.
* Solve problems involving motion of particles in fluid, fluid–solid operations in packed beds and fluidized beds.
* Select machinery and measuring devices for fluid flow.

## SYLLABUS

**Dimensional Analysis:** Units and Dimensions, Dimensional Homogeneity, Dimensional Analysis, Buckingham ð theorem, Geometric similarity, kinematic similarity, and dynamic similarity.

**Fluid Statics and Applications:** Nature of fluids, Hydrostatic Equilibrium, Applications of fluid statics – Manometers, continuous gravity decanter and centrifugal decanter.

**Fluid Flow Phenomena:** Laminar flow, shear rate, shear stress. Rheological properties of fluids – Newtonian fluids, Non Newtonian fluids, time dependent flow, viscoelastic fluids. Viscosity, Reynolds number, Turbulence - nature of turbulence, deviating velocities, intensity and scale of turbulence, Reynolds stresses and eddy viscosity. Boundary layers - boundary layer formation over flat plate, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary layer formation in straight tubes, boundary layer separation and wake formation.

**Basic Equations of Fluid Flow:** Continuity equation (Mass Balance in a flowing fluid), equation of motion (Differential Momentum Balance), Navier - stokes equations, Euler's equation, Couette flow, Macroscopic Momentum Balance, layer flow with free surface, Bernoulli equation (Energy equation), corrections for effect of solid boundaries and pump work.

**Incompressible Flow in Pipes and Channels :** Shear Stress and skin friction in pipes, Relation with skin friction and wall shear, Friction factor, relations between skin friction parameters, equivalent diameter, laminar flow in pipes and channels, velocity distribution, average velocity, Kinetic energy correction factor and momentum correction factor for laminar flow, Hagen-Poiseuille equation, laminar flow of non-Newtonian liquids, laminar flow in annulus. Turbulent flow in pipes and channels, Velocity distribution for turbulent flow, universal velocity distribution equations, its limitations, flow quantities for turbulent flow in smooth round pipes, Reynolds number- friction factor law for smooth tubes, effect of roughness, friction factor chart, drag reduction, friction from changes in velocity or direction – sudden expansion, sudden contraction, pipe fittings, friction losses in Bernoulli equation, velocity heads, separation of boundary layer in diverging channel, minimizing losses.

**Flow in Compressible Fluids:** Definitions and basic equations, processes of compressible flow, isentropic flow through nozzles, Adiabatic friction flow, Isothermal friction flow

**Flow Past Immersed Objects:** Drag and drag coefficients, flow through bed of solids, Motion of particles through fluids - mechanics of particle motion, equation for one-dimensional motion of particles through fluid, terminal velocity, criterion for settling, free and hindered settling. Fluidization – conditions, minimum fluidization velocity, types of fluidizations and its applications.

**Transportation and Metering of Fluids:** Pipes, fittings, valves. Positive displacement Pumps – reciprocating, rotary and peristaltic pumps. Centrifugal pumps - theory, construction, performance, single and multistage pumps. Fans, Blowers and Compressors. Vacuum pumps – jet ejectors.

**Metering of Fluids:** Full bore meters – Venturi meter, Orifice meter, Rotameters, Vortex-Shedding meters, Magnetic meters and Coriolis meters. Insertion meters – Pitot Tube, Thermal meters, notches and weirs.

Text Book:

"Unit Operations of Chemical Engineering" Seventh Edition, by W.L. McCabe, J C Smith and P Harriot, Mc Graw Hill

Reference Book:

"Chemical Engineering" Volume I by Coulson J.M. and Richardson J.F, Elsevier

"Fluid Mechanics" 2nd edition by Noel de Nevers, Mc Graw Hill

## CH-2103 : PARTICLE & FLUID PARTICLE PROCESSING

**Course Objectives:**

Mechanical Operations is one of the core subjects for chemical engineers, where student can learn some of the unit operations necessary for process industry. Main objectives of the inclusion of this subject are:

* To make the students exposed to different geometrical sizes of raw materials used in the industries, area of calculation of the particles w.r.t their sizes
* To get familiarity with the different laws of grinding
* To do the power consumption calculations
* To learn different separation process on their physical properties
* To differentiate between the process such as mixing and agitation
* To know the movement of particles in different liquids (viscous)

**Course Outcomes:**

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

* Select suitable size reduction equipment based on performance and power requirement.
* Analyze particle size distribution of solids
* Evaluate solid-fluid separation equipment
* Determine the power required for agitation, blending and mixing
* Select conveyers for the transportation of materials in the industry

## SYLLABUS

**Characteristics of Solid Particles:** shape, size, differential and cumulative screen analysis, specific surface area, particle population, different mean diameters for a mixture of particles.

**Principles of Communication**: Laws of crushing, description and working of size reduction equipment - jaw, gyratory and roll crushers, hammer mills, revolving mills, attrition mills, fluid energy mill, cutting machines, open and closed circuit grinding, wet and dry grinding, grindability index.

**Size Separation:** screening, industrial screens - grizzly, gyratory and vibratory screens, revolving screens, trammels, capacity and effectiveness of screens, magnetic separation, electrostatic separation, froth flotation.

**Filtration:** Description and working of filtration equipment, plate and frame filter press, shell and leaf filters, rotary drum filter, filter aid, centrifugal filtration, top suspended batch centrifuge, theory of filtration, washing of cakes.

**Motion of Particles Through Fluids**: Drag, free and hindered settling, settling velocities, classification, sink and float methods, differential setting methods - jigging and tabling, cyclone separators.

**Batch Sedimentation:** Thickeners, flocculation, centrifugal sedimentation, gravity and centrifugal decanters.

**Agitation of Liquids:** Power consumption in agitated vessels, scale up of agitation equipment, mixing equipment for mixing of solids and pastes, mixers for dry powders, mixing index.

**Conveying**: types of conveyors – mechanical, belt, chain and screw conveyors, elevators, pneumatic conveyors, size enlargement - need and applications.

Text Book:

'Unit Operations of Chemical Engineering' by W.L. McCabe, J.C. Smith and P.Harriot, McGraw- Hill Book Company

Reference Books:

1. 'Chemical Engineering -Vol.2' by J.H.Coulson and J.F.Richardson, Pergaman press and ELBS
2. 'Chemical Engineer's Hand Book' by R.H.Perry {ed}, McGraw-Hill Book Co.
3. 'Unit Operations' by Brown et al., Asian Publishing House
4. 'Introduction to Chemical Engineering' by Badger and Banchero, McGraw-Hill Book Company

## CH-2104 : HEAT TRANSFER

**Courses Objectives:**

* To study the fundamental concepts of heat transfer viz., conduction, convection, radiation.

* To use these fundamentals in typical engineering applications (Heat exchanger and Evaporator, boiling and condensation.) and current research

**Course Outcomes:**

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

* Analyze problems involving steady state heat conduction in simple geometries

* Develop equations for different types of convection and solve for heat transfer rate by convection in flow through pipes and flow over a flat plate

* Design of shell and tube heat exchangers using LMTD and effectiveness method

* Estimate the rate of radiation heat transfer with and without participating medium and ability to identify the roll of radiation shields

* Estimate steam economy, capacity of single and multiple effect evaporators

* Understand the concepts of boiling and condensation

### SYLLABUS

**Nature of Heat Flow:** Conduction, convection, natural and forced convection, radiation.

**Heat transfer by Conduction :** Basic laws of conduction, thermal conductivity; Steady-state conduction – compound resistances in series, heat flow through a cylinder; Unsteady-state conduction – one dimensional heat flow with constant surface temperature, het flow with variable surface temperature, semi-infinite solid.

**Heat transfer by Convection:** Principles of heat flow in fluids – Typical heat exchange equipment, countercurrent and parallel flows, energy balances, heat flux and heat transfer coefficients, overall heat transfer coefficients, integration over total surface, LMTD, individual heat transfer coefficients.

**Heat Transfer to Fluids without Phase Change :** Boundary layers, laminar flow heat transfer, correction for heating and cooling, heat transfer in turbulent flow, estimation of wall temperature, cross-sections other than circular, analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids outside tubes, natural convection.

**Heat Transfer to Fluids with Phase Change:** heat transfer from condensing vapors, heat transfer to boiling liquids.

**Radiation Heat Transfer:** Fundamental facts concerning radiation, emission of radiation, absorption of radiation by opaque solids, radiation between surfaces, radiation to semitransparent materials, combined heat transfer by conduction-convection-radiation.

**Heat-exchange Equipment:** General design of heat exchange equipment, shell and tube heat exchangers, plate-type exchangers, extended surface equipment, heat pipes, scraped-surface exchangers, condensers and vaporizers, heat transfer in agitated vessels, heat transfer in packed beds.

**Evaporation:** Evaporation, types of evaporators, performance of tubular evaporators, multiple-effect evaporators, methods of feeding, vapor compression.

Text Book:

Unit Operations of Chemical Engineering, ***7***th Ed. by W. L. McCabe, J. C. Smith and P. Harriot, McGraw Hill International Edition, Singapore (2005).

Reference Book:

Process Heat Transfer, by D. Q. Kern, Tata McGraw Hill, New Delhi.

## CH-2105 : MANAGERIAL ECONOMICS

**Course Objectives:**

* To bring about an awareness about the nature of Managerial Economics and its linkages with other disciplines.

* To understand the Micro and Macro Environment of Business.

* To familiarise the prospective engineers with the concepts and tools of Managerial Economics with an objective to understand the real world of business.

**Course Outcomes:**

* Managerial Economics will help the prospective engineers, who are likely to occupy managerial positions in future to understand the various economic activities in business and industry for an effective and efficient running of the organisations.

## SYLLABUS

Significance of Economics and Managerial Economics:

**Economics:** Definitions of Economics- Wealth, Welfare and Scarcity definition Classification of Economics- Micro and Micro Economics.

**Managerial Economics:** Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

**Demand Analysis :**Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve.

**Elasticity of Demand** - Definition, Measurement of elasticity, Types of Elasticity ( Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

**Demand Forecasting -** Need for Demand forecasting, Factors governing demand forecasting, Methods of demand forecasting: Survey methods- Experts' opinion survey method and consumers Survey methods.

**Utility Analysis:** Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations

Theory of Production and Cost Analysis:

**Production -** Meaning, Production function and its assumptions, use of production function in decision making; Law of Variable Proportions: three stages of the law

**Cost Analysis -** Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. unavoidable costs, Economies and Diseconomies of scale

**Market Structures** : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve ;Monopolistic Competition

**Pricing Analysis** : Pricing - Significance: Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark-down pricing of retailers.

Business cycles, Inflation and Deflation: **Business Cycles** - Definition , Characteristics , Phases, Causes and Consequences; Measures to solve problems arising from Business cycles.

**Inflation -**Meaning, Types, Demand- pull and Cost push inflation, Effects of Inflation, Anti- inflationary measures.

**Deflation-** Meaning, Effects of Deflation, Control of Deflation, Choice between Inflation and Deflation.

Text Books:

1. Sankaran,S., **Managerial Economics,** Marghan Publications, 2015, Chennai.

2. Aryasri, A.R., **Managerial Economics and Financial Analysis,** MC Graw Hill Education, New Delhi,2015.

## CH-2106 : FLUID MECHANICS LABORATORY

**Course Objectives:**

* The student will be exposed to various fluid measuring devices. The pressure drop calculation experimentally across the pipe fittings, valves, packed bed, fluidized bed and annulus will also be dealt in this lab.

**Course Outcomes:**

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

* Distinguish laminar and turbulent flows.

* Determine the characteristics of flow meters

* Determine the characteristics of packed & fluidized beds and centrifugal pumps

* Calculate pressure drop across a pipe, valves and fittings.

**List of Experiments:**

1. Identification of laminar and turbulent flows (Reynolds apparatus)
2. Measurement of point velocities (Pitot tube)
3. Verification of Bernoulli equation
4. Calibration of rotameter
5. Variation of orifice coefficient with Reynolds number
6. Determination of venturi coefficient
7. Friction losses in fluid flow in pipes
8. Pressure drop in a packed bed for different fluid velocities

9. Pressure drop and void fraction in a fluidized bed

10. To study the coefficient of contraction for a given open orifice

11. To study the coefficient of discharge in a V - notch

12. To study the characteristics of a centrifugal pump

## CH-2107 : PARTICLE & FLUID PARTICLE PROCESSING LABORATORY

**Course Objectives:**

* Solid processing is an essential component in process industries. In the present day, when the world is facing the challenge of dealing with depleting mineral resources, this subject assumes high importance to the students of chemical engineering. The student is introduced to the concepts of sampling, processing of solid raw materials. The student also gets hands on training on operating various machines used for processing of solids.

**Course Outcomes:**

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

* Select suitable methods for size reduction of minerals or other intermediates

* Analyze particle size distribution of solids

* Evaluate suitable mechanical separations of powders, solid-liquid and solid-gas mixtures

**List of Experiments:**

1. To take a representative sample from a bulk by two methods, viz. Riffle and cone & quartering and to find out the average size (volume-surface mean diameter) of the samples

2. To determine the grindability index {GI} of coal by hard groove machine

3. To determine the time of grinding in a ball mill for producing a product with 80% passing a given screen

4. To verify the laws of crushing using any size reduction equipment like crushing rolls, ball mill or vibrating mill and to find out the work Index {WI} of the material

5. To compare open circuit and closed circuit grinding by means of a ball mill

6. To determine the optimum time of sieving for a given sample of material

7. To find the effectiveness of hand screening of a given sample by a given screen

8. To find the screen effectiveness of a trommel

9. To separate a mixture of coal into two fractions using sink and float method

10. To separate a mixture of coal into two fractions using froth flotation technique

11. To find the size analysis of a given fine sample using beaker decantation method

12. To separate a mixture of particles by jigging

13. To concentrate a given material by means of tabling

14. To obtain batch sedimentation data and to calculate the minimum thickener area under given conditions

15. To determine the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press.

## CH-2108 : HEAT TRANSFER LABORATORY

**Course Objectives:**

* The student will calculate the thermal resistance and calculation of heat transfer coefficients for both natural and forced convection scenarios. The student will conduct experiments to calculate emissivity of the given plate, radiation constant of the given rod and Stefen Boltzman constant.

**Course Outcomes:**

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

* Determine thermal conductivity of composite solids and thermal conductivities of lagging material in lagged pipe apparatus.

* Determine heat transfer coefficients in forced and natural convection.

* Determine the Stefan Boltzmann constant and emissivity of the given plate.

* Calculate radiation constant for hot rod loosing heat to the infinite stagnant ambient.

* Analyze the heat exchanger performance(double pipe) for co-current and counter-current flows and determine overall heat transfer coefficient.

**List of Experiments:**

1. Determination of total thermal resistance and thermal conductivity of composite wall.

2. Determination of total thermal resistance and thermal conductivity of Lagged pipe.

3. Determination of the natural convective heat transfer coefficient for a vertical tube.

4. Determination of forced convective heat transfer coefficient for air flowing through a pipe.

5. Determination of over-all heat transfer coefficient in double pipe heat exchanger.

6. Study of the temperature distribution along the length of a pin fin under natural and forced convection conditions.

7. Estimation of unsteady state film heat transfer coefficient between the medium in which the body is cooled.

8. Determination of Stefan-Boltzmann constant.

9. Determination of emissivity of a given plate at various temperatures.

10. Determination of radiation constant of a given surface.

11. Determination of the thermal conductivity of a metal rod.

12. Determination of critical heat flux point for pool boiling of water

## CH-2109 : MATLAB

**Course Objectives:**

* The student will learn to apply the knowledge of *MATLAB* for solving Chemical Engineering problems.

**Course Outcomes:**

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

* Apply MAT Lab to create and print arrays and execute function files

* Solve linear equations using MAT Lab

* Determine the curve fit equation for the given data

* Draw 2D plots and 3D plots for the given data

## SYLLABUS

**Introduction:** Tutorial lessons: MATLAB session, working with arrays of numbers, creating and printing simple data, saving and executing a script file, creating and executing function files, working with files and directories.

**Interactive Computation:** Matrices and vectors, matrix and array operations, creating and using inline functions, using built in functions and online help, saving and loading data, plotting simple graphs.

**Script files**: function files, language specific features, advanced data objects.

**Applications:** linear algebra, curve fitting and interpolation, data analysis and statistics, numerical integration, ordinary differential equations, nonlinear algebraic equations.

**Basic 2D plots**: using subplot to layout multiple graphs. 3-D plots, symbolic Math tool box: two useful tools in symbolic Math tool box, using symbolic Math tool box.

Text Book:

'Getting started with MATLAB: A quick introduction for scientists and engineers' by Rudra Pratap, Oxford University press

## CH-2110 : PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Common for all B.Tech and B.Tech+M.Tech Integrated Courses
(w.e.f. 2022-2023)

**Course Objectives:**

* To recognize the moral values that should guide the Engineering profession.

* To resolve moral issues concerning one's profession.

* To develop and exhibit a set of moral beliefs and attitudes that engineers should inculcate.

* To inculcate social values and morality in one's life.

* To develop awareness about Professional/Engineering Ethics and Human Values.

**Learning Outcomes:**

Students will be able to:

* Apply the conceptual understanding of ethics and values into everyday practice.

* Understand the importance of moral awareness and reasoning in life.

* Acquire professional and moral etiquette that an engineer requires.

* Develop the acumen for self-awareness and self-development.

* Develop cultural tolerance and integrity.

* Tackle real-life challenges with empathy.

## CONTENTS

Unit - I: HUMAN VALUES : Values - Respect - Caring - Sharing - Honesty- Courage - Self confidence - Communal Harmony Morals - Virtues

Unit –II PROFESSIONAL VALUES : Integrity - Discipline - Valuing time - Cooperation - Commitment - Code of conduct - Challenges in the workplace

Unit – III PROFESSIONAL ETHICS : Overview - Engineering ethics - Moral issues - Profession - Models of professional roles - Responsibility

Unit – IV RESPONSIBILITIES AND RIGHTS : Safety and risk - Collegiality and loyalty - Confidentiality - Occupational crime - Human rights - Employee rights - Intellectual property rights

Unit – V GLOBAL ISSUES : Globalization - Environmental ethics - Computer ethics - Code of ethics - Multinational corporations - Engineers as advisors in Planning and Policy making

Suggested Textbook:

R.S. Nagarazan. *A Textbook on Professional Ethics and Human Values.* New Age International Publishers. 2006.

Reference Books:

Premvir Kapoor. Professional Ethics and Human Values. Khanna Publishing House. 2019.

B.S. Raghavan. *Human Values and Professional Ethics*. S.Chand Publications. 2012.

R.R. Gaur & Others. *A Foundation Course in Human Values and Proff. Ethics*. Excel Books. 2009.

A. N. Tripathi. *Human Values*. New Age International (P) Limited. 2009

R. Subramanian. *Professional Ethics*. OUP India. 2013.

## CH-2111 : NCC/NSS

All the students should enroll either in NCC or NSS and get a satisfactory report.

## CH-2201 : MATERIALS SCIENCE & ENGINEERING

**Course Objectives:**

Materials science and engineering is an important subject to every engineer to understand about the materials' behavior in different environments. Main objectives of the study are as follows:

* To understand the structure of atoms

* To learn something about the crystalline nature of the materials

* To know about the influence of atoms controlling the properties of materials

* To know the equivalency of the materials for replacement

* To learn to prepare alloys, composites for conventional materials

* To find the relation between arrangement an thermodynamic properties of materials

**Course Outcomes:**

* To know about the appropriate utility of materials based on their nature.

* To know the behavior of the materials w.r.t their directions.

* To know the behaviour of materials exposed to different conditions in different phases.

* To calculate the stability materials and knew the importance of crystalllinity.

* Selectivity of the materials for suitable design to manufacture the machines

* To improve the properties choosing alternative materials suchas alloys, composites instead of conventional materials (to minimize fractures, wear and tear).

* Leads to prepare some knew semiconductors for important purposes.

### SYLLABUS

**An introduction to materials**: Classification of engineering materials, brief review of atomic structure, calculation of energy of electron of Bohr's atomic model, Bonds in materials – classification, properties of ionic, covalent and metallic solids, variation in bonding character and properties. Crystal Geometry and crystal structure – solids- crystalline solids and amorphous solids (non-crystalline), differences between crystalline and non-crystalline materials. Ideal crystal, space Lattice, unit cell, primitive cell, non-primitive cell, lattice co-ordinates, Bravis lattices for crystal systems, crystal systems and their properties, symmetry and elements of symmetry, Atomic packing faction and packing efficiency (SC, BCC, FCC, Diamond cubic and HCP structures), c/a ratio for HCP structure. Miller indices for directions and linear density calculation, planes in crystals and their representation, planar density calculation, coordination number. Determination of crystal Structure by X-ray diffraction method – Debye method, numerical problems for different cubic structures (SC, BCC and FCC).

**Fundamentals of Thermodynamics** : Stability and meta-stability of materials, internal energy (E), enthalpy (H), Gibb's free Energy (G), and thermal entropy and configurational entropy (S). solid solutions-types, crystal imperfections – classification, point defects- classification and estimation of point defects in the crystals; Imperfections (dislocations) – classification (edge and screw); Berger circuits and Burgers Vector, planar defects, volume defects, dislocation reactions, role of dislocations in determining crystal properties; surface defects - types

**Mechanical Properties:** Stress –types of stresses; Strain-types of strain; true stress and true strain, engineering stress and engineering strain of the materials, relation between engineering strain and true strain, relation between engineering stress and true stress; Hooke's Law; Poisson's Ratio, stress-strain diagram and its uses; different moduli of elasticity – Young's modulus, shear modulus, and bulk modulus; relation between different moduli of elasticity, strain vs stress relationship diagrams for different materials (metals, non-metals, rubbers and plastics and polymers); elastic deformation and plastic deformation and their differences. Critical Resolved shear stress (CRSS). Fracture – types, ductile fracture and its mechanism, brittle fracture and its mechanism (Griffith's criteria), fatigue factors affecting the fatigue, creep and creep failure mechanisms, creep resistance materials. Composite materials – classification, advantages of composite materials over conventional materials, Limitations of composite materials, factors affecting the performance

of fibrous composites, factors affecting the performance of matrix in composites, Phase- time scale for phase changes, Phase diagrams- phase rule, single component systems, Binary phase changes, the lever rule and numerical problems, advantages of phase diagrams, advantages of alloying of metals on the properties of steels, Iron-iron carbide (Fe-$Fe_3C$) phase diagram, limitations of plain carbon steels, types of steels used in chemical industries,

**Corrosion and Prevention:** Principles and mechanism of corrosion, types of corrosion cells: composition cell, concentration cell, stress cells, Different forms of corrosion, prevention and control of corrosion: proper selection of materials, proper design and fabrication procedure, application of protective coatings.

Text Books:

1. 'Materials Science & Engineering' by V.Raghavan, Prentice Hall of India Ltd, New Delh
2. 'Elements of Materials Science & Engineering', 5th Edition, Lawrence H.VanVlack, Addision-Weley Publishing Company

Reference Books:

1. 'Science of Engineering Materials', Vols.1-3, by Manas Chanda, McMillan Company of India, Delhi
2. 'Principles of Materials Science & Engineering', William F.Smith, McGraw-Hill Publishing Co.
3. 'Essentials of Materials Science' by A.G. Guy.
4. A textbook of Engineering physics, by Dr.M.N.Avadhanulu and Dr.P.G.Kshirsagar; S.Chand and company pvt Ltd. Chapters 26 and 27.
5. An introduction to corrosion science and engineering By Herbert Uhilig and R. Winston Revie, Published by John Wiley and sons, New York.
6. Corrosion Engineering by Mars.G.Fontana, McGraw-Hill, publication

## CH-2202 : PYTHON PROGRAMMING

**Course Objectives**

1. To develop skills on procedural oriented and object oriented programming in Python
2. To understand and apply different data wrangling techniques using Python.
3. To perform data analysis using python libraries like NumPy, Pandas and exploratory data analysis using Matplotlib

**Course Outcomes**

At the end of the course, a student should be able to:

1. acquire programming knowledge on Basics of Python
2. acquire programming knowledge on Text and File Handling
3. develop Python programs to Mean, Median, Mode, Correlation
4. acquire programming knowledge on NumPy, Pandas Library
5. acquire programming knowledge on Graph Visualizations in Python and Data Analysis using Python

**SYLLABUS**

1. Introduction to Python: Rapid Introduction to Procedular Programming, Data Types: Identifiers and Keywords, Integral Types, Floating Point Types

Strings: Strings, Comparing Strings, Slicing and Striding Strings, String Operators and Methods, String formatting with str.format

Collections Data Types: Tuples, Lists, Sets, dictionaries, Iterating and copying collections

2. Python Control Structures, Functions and OOP: Control Structures and Functions: Conditional Branching, Looping, Exception Handling, Custom Fuctions Python Library Modules: random, math, time, os, shutil, sys, glob, re, statistics, creating a custom module

Object Oriented Programming: Object Oriented Concepts and Terminology, Custom Classes, Attributes and Methods, Inheritance and Polymorphism, Using Properties to Control Attribute Access

File Handling: Writing and Reading Binary Data, Writing and Parsing Text Files

3. NumPy Arrays and Vectorized Computation: NumPy arrays, Array creation, Indexing and slicing, Fancy indexing, Numerical operations on arrays, Array functions, Data processing using arrays, Loading and saving data, Saving an array, Loading an array, Linear algebra with NumPy, NumPy random numbers

4. Data Analysis with Pandas: An overview of the Pandas package, The Pandas data structure-Series, The DataFrame, The Essential Basic Functionality: Reindexing and altering labels , Head and tail, Binary operations, Functional statistics , Function application Sorting, Indexing and selecting data, Computational tools, Working with Missing Data, Advanced Uses of Pandas for Data Analysis - Hierarchical indexing, The Panel data

5. Data Analysis Application Examples: Data munging, Cleaning data, Filtering, Merging data, Reshaping data, Data aggregation, Grouping data

6. Data Visualization: The matplotlib API primer-Line properties, Figures and subplots, Exploring plot types-Scatter plots, Bar plots, Histogram plots, Legends and annotations, Plotting functions with Pandas

Text Books

1. Programming in Python 3: A Complete Introduction to Python Language, Mark Summerfield, Second Edition, Addison-Wesley Publications

2. Python: End-to-End Data Analysis Learning Path, Module 1: Getting Started with Python Data Analysis , Phuong VothiHong , Martin Czygan, , Packt Publishing Ltd

Reference Books

1. Learning Python, 5th Edition, Mark Lutz, Orielly Publications
2. Python for Data Analysis, Wes McKinney, Orielly Publications
3. How to Think Like a Computer Scientist: Learning with Python 3 Documentation 3rd Edition, Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers
4. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall
5. Python Cookbook – Recipes for Mastering Python 3,3rdEdition, David Beazley, Brian K. Jones, Oreilly

## CH-2203 : MATERIAL & ENERGY BALANCES

**Course Objectives:**

* To give intensive quantitative training in the practical applications of the principles of physical chemistry to the solution of complicated industrial problems and in methods of predicting missing physicochemical data from generalized principles.

**Course Outcomes:**

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

* Convert physico-chemical quantities from one system of units to another.
* Identify basis and degrees of freedom.
* Perform material and energy balances on single units without and with chemical reactions.
* Solve the material and energy balance problems on multi-unit processes with recycle, purge and bypass.
* Analyze the ideal and real behavior of gases, vapors and liquids.

## SYLLABUS

**Stoichiometry and Composition Relationships**: The gram-mole and pound-mole, limiting reactant, excess reactant, degree of completion, basis of calculation, weight percent, volume percent and mole percent, density and specific gravity- Baume and API gravity scales.

**Behavior of Ideal Gases**: Application of the ideal-gas law, Dalton and Amagat laws to gaseous mixtures, composition of gases on dry basis and on wet basis.

**Vapor Pressures**: Effect of temperature on vapor pressure, Antoine equation, reference substance vapor pressure plots, vapor pressure of immiscible liquids, ideal solutions and Raoult's law, non-volatile solutes.

**Humidity:** Percentage saturation, relative saturation or relative humidity, dew point, vaporization, condensation, wet and dry bulb temperatures, adiabatic vaporization and adiabatic saturation temperature.

**Material Balances:** Tie substance, yield, conversion, processes involving chemical reactions, material balance- calculations involving drying, dissolution, and crystallization, processes involving recycle, bypass and purge.

**Heat Capacities of Gases and Gaseous Mixtures:** Effect of temperature on heat capacity of gas, mean heat capacity of gas, Kopp's rule, latent heats, heat of fusion, heat of vaporization, Trouton's rule, Kistyakowsky equation for non-polar liquids, estimation of latent heat of vaporization using Classius-Clayperon equation, enthalpy of humid air and humid heat capacity.

**Standard Heat of Reaction:** Standard heat of formation, laws of thermochemistry, standard heat of combustion, calculation of heat of formation from heats of combustion, calculation standard heat of reaction from heats of formation and from heats of combustion, standard integral heat of solution, effect of temperature on heat of reaction, Kirchoff's equation, adiabatic and non-adiabatic reactions, theoretical and actual flame temperatures.

Text Book:

'Chemical Process Principles, Part-I - Material and Energy balances' by Olaf A Hougen, K.M. Watson and R.A.Ragatz, CBS Publishers and Distributors (1995)

Reference Books:

1. 'Basic principles and Calculations in Chemical Engineering' by David M. Himmelblau, Prentice Hall of India Pvt Ltd, 1995
2. 'Stoichiometry' by B.I. Bhatt and S.M. Vora, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi (1996)
3. 'Stoichiometry for Chemical Engineers' by Williams and Johnson, McGraw Hill Publishers.

## CH-2204 : CHEMICAL ENGINEERING THERMODYNAMICS

**Course Objectives:**

Knowledge of thermodynamics helps student compute heat and work requirements of a process.

The student would also learn

* How to estimate data in case of absence of experimental data.
* Solution thermodynamics and its applications.
* Concept of Phase & Chemical reaction equilibrium.

**Course Outcomes:**

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

* Apply the first and second laws of thermodynamics to chemical processes and Compute the properties of ideal and real gas mixtures.

* Evaluate heat effects involved in industrial chemical processes.

* Evaluate the efficiency of expansion and compression flow processes and analyze refrigeration and liquefaction processes.

* Determine thermodynamic properties of gaseous mixtures and solutions, Estimate Bubble-P & T, Dew-P & T for binary and multi-component systems and Calculate vapor-liquid equilibrium (VLE) composition for ideal and non-ideal systems.

* Determine equilibrium constant and composition of product mixture for single and multiple reactions.

## SYLLABUS

**The First Law and other Basic Concepts:** Introduction to Basic laws and Terminologies in Thermodynamics- Statement of First law, the steady-state, steady-flow process, the reversible process.

**Volumetric Properties of Pure Fluids:** PVT behavior of pure substances, the ideal gas, virial equations and its applications, cubic equations of state, generalized correlations for gases and liquids.

**Heat Effects:** Latent heats of pure substances, Temperature dependence of heat effects of chemical reactions.

**The Second Law of Thermodynamics:** Statements of second law-Clausius Inequality-Mathematical Statement of Second law, Third law of thermodynamics.

**Thermodynamic Properties of Pure Fluids:** Property relations for homogeneous phases, residual properties.

**Solution Thermodynamics:** chemical potential, partial properties, ideal gas mixtures, fugacity and fugacity coefficient for a pure species and species in solution, generalized correlations for the fugacity coefficients, the ideal solution, excess properties. VLE-Duhem's theorem, VLE- qualitative behavior, Raoults law and modified Raoults law, dew point and bubble point calculations, flash calculations.VLE for Ideal solutions, Calculation of activity coefficients.

**Chemical Reaction Equilibria:** Criteria for chemical reaction equilibrium, the standard Gibbs energy change and the equilibrium constant, Effect of temperature, pressure, composition and other factors.

Text Book:

'Introduction to Chemical Engineering Thermodynamics' by J.M.Smith, H.C.Van Ness and M.M.Abbott., 6th Edition, Tata McGraw-Hill Edition 2003.

Reference Books:

1. 'Chemical Engineering Thermodynamics' by B.F.Dodge, McGraw-Hill Book Co.,

2. 'Schaum Outline of Theory and Problems of Thermodynamics' by Michael M. Abbott and Hendrick C.VanNess, McGraw-Hill International Book Co., Singapore, 1981.

3.'Chemical Engineering Thermodynamics' by Y.V.C.Rao, University Press (India) Ltd., Hyderabad 1997.

4. K.V.Narayanan, A Textbook of Chemical Engineering Thermodynamics, PHI Learning, 2004.

## CH-2205 : GENERAL CHEMICAL TECHNOLOGY

**Course Objectives:**

* To provide the student understanding of importance of chemical process industries over the other manufacturing industries.

* To provide the brief introduction of chemical process equipments, the application of thermodynamics, the chemical process principles, the equipment design and also the corrosion and the safety aspects to consider in the chemical manufacturing processes.

* To provide basic inorganic chemistry background required for the undergraduate students of engineering.

* To provide an overview of chemical properties of inorganic chemicals and the manufacturing processes.

* To provide an overview of applications of materials which the engineers are likely to use during their professional career.

**Course Outcomes:**

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

* Selection of a process for manufacture of chemicals

* Draw process flow diagrams

* Identify the engineering problems in chemical processes

* List chemical reactions and their mechanism involved

## SYLLABUS

**Nitrogen industries:** Manufacture of ammonia, nitric acid, urea and ammonium nitrate.

Phosphorous and phosphoric acid industries: Methods for production of phosphorous and phosphoric acid, manufacture of super phosphate and triple super phosphate.

**Cement:** Types of cement, manufacture of ordinary Portland cement, slag cement.

Coal and Coal chemicals: distillation of coal and coal tar, low and high temperature carbonization of coal.

**Petrochemicals:** Derivatives of $C_2$: Polyethylene, Ethanol, Ethylene oxide; Derivatives of $C_3$: Isoproponol, Acetone, Propylene oxide

**Extraction of Vegetable Oils:** Purification, acid value, hydrogenation of oils, Manufacture of fatty acids, soaps and detergents classification and manufacture.

**Paints and Varnishes:** Constituents of paints, functions of paint, manufacturing procedures, Pigments-manufacture of lithophone, varnishes

**Manufacture of Pulp and Paper:** Kraft process and sulphite process, production of paper Manufacture of Sugar

Textbooks:

1. "Dryden's Outlines of Chemical Technology" by M.Gopala Rao & Marshall Sitting (Editors). Affiliated East West Press Pvt. Ltd.

2. "Shreve's Chemical Process Industries" by G.T.Austin, McGraw Hill Books

Reference Book:

"Encyclopedia of Chemical Technology" by R.E.Kirk & D.F.Othmer (Editors)Interscience.

## CH-2206 : PYTHON PROGRAMMING LABORATORY

**Course Objectives**

1. familiarize students with key data structures in Python including lists and dictionaries and apply them in context of searching, sorting, text and file handling

2. introduce students to calculation of statistical measures using Python such as measures of central tendency, correlation

3. familiarize students with important Python data related libraries such as Numpy and Pandas and use them to manipulate arrays and dataframes

4. introduce students to data visualization in Python through creation of line plots, histograms, scatter plots, box plots and others

5. implementation of basic machine learning tasks in Python including pre-processing data, dimensionality reduction of data using PCA, clustering, classification and cross-validation.

**Course Outcomes**

After completion of the course the student should be able to:

1. implement searching, sorting and handle text and files using Python data structures such as lists and dictionaries

2. calculate statistical measures using Python such as measures of central tendency, correlation

3. use Python data related libraries such as Numpy and Pandas and create data visualizations

4. implement basic machine learning tasks pre-processing data, compressing data, clustering, classification and cross-validation.

## SYLLABUS

1. Python Programs on lists & Dictionaries

2. Python Programs on Searching and sorting

3. Python Programs on Text Handling

4. Python Programs on File Handling

5. Python Programs for calculating Mean, Mode, Median, Variance, Standard Deviation

6. Python Programs for Karl Pearson Coefficient of Correlation, Rank Correlation

7. Python Programs on NumPy Arrays, Linear algebra with NumPy

8. Python Programs for creation and manipulation of DataFrames using Pandas Library

**9.** Write a Python program for the following**.**

* Simple Line Plots,

* Adjusting the Plot: Line Colors and Styles, Axes Limits, Labeling Plots,

* Simple Scatter Plots,

* Histograms,

* Customizing Plot Legends,

* Choosing Elements for the Legend,

* Boxplot

* Multiple Legends,

* Customizing Colorbars,

* Multiple Subplots,

* Text and Annotation,

* Customizing Ticks

10. Python Programs for Data preprocessing: Handling missing values, handling categorical data, bringing features to same scale, selecting meaningful features

11. Python Program for Compressing data via dimensionality reduction: PCA

12. Python Programs for Data Clustering

13. Python Programs for Classification

14. Python Programs for Model Evaluation: K-fold cross validation

Reference Books

1. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall

2. Chris Albon, "Machine Learning with Python Cookbook-practical solutions from preprocessing to Deep learning", O'REILLY Publisher,2018

3. Mark Summerfield, Programming in Python 3—A Complete Introduction to the Python Language, Second Edition, Additson Wesley

4. Phuong Vo.T.H , Martin Czygan, Getting Started with Python Data Analysis, Packt Publishing Ltd

5. Armando Fandango, Python Data Analysis, Packt Publishing Ltd

6. Magnus Vilhelm Persson and Luiz Felipe Martins, Mastering Python Data Analysis, Packt Publishing Ltd

7. Sebastian Raschka& Vahid Mirjalili, "Python Machine Learning", Packt Publisher, 2017

## CH-2207 : GENERAL CHEMICAL TECHNOLOGY LABORATORY

**Course Objectives:**

* The student will be made familiar with analysis of water, oils, coal, lime stone, bleaching powder saw dust etc. and preparations of soap, copper and chrome yellow pigments, Phenol formaldehyde resins.

**Course Outcomes:**

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

* Synthesize products such as soap, phenol formaldehyde resin, Chrome yellow pigment, and Copper pigment

* Estimation of total solids, dissolved solids,pH, chlorides, sulphates, temporary and permanent hardness in water

* Analyse acid value, Iodine value and sopanification value of oil

* Estimate the purity of various materials

**List of experiments:**

A. Analysis of water:

1. Total solids, dissolved solids,pH
2. Chlorides and sulphates
3. Temporary, permanent and total hardness.

B. Analysis of oils:

4. Acid value
5. Iodine value
6. Saponification value

C. Miscellaneous analysis:

7. Analysis of coal: Proximate analysis
8. Analysis of lime: Estimation of acid insoluble's, available lime and calcium carbonate
9. Analysis of bleaching powder: Estimation of chlorine content.
10. Analysis of starch/glucose: Estimation of total reducing sugars
11. Analysis of saw dust: Estimation of total cellulose and –cellulose

E. Miscellaneous preparations:

12. Preparation of soap
13. Preparation of copper pigment
14. Preparation of chrome yellow pigment
15. Preparation of phenol formaldehyde resin

## CH-2208 : COMPUTER AIDED MACHINE DRAWING

**OBJECTIVES:**

* To make the students understand and interpret drawings of machine components v

* To prepare assembly drawings both manually and using standard CAD packages v

* To familiarize the students with Indian Standards on drawing practices and standard components

* To gain practical experience in handling 2D drafting and 3D modeling software systems.

DRAWING STANDARDS & FITS AND TOLERANCES Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning & tolerancing.

INTRODUCTION TO 2D DRAFTING v Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing. v Bearings - Bush bearing, Plummer block v Valves – Safety and non-return valves.

3D GEOMETRIC MODELING AND ASSEMBLY Sketcher - Datum planes – Protrusion – Holes - Part modeling – Extrusion – Revolve – Sweep – Loft –

Blend – Fillet - Pattern – Chamfer - Round - Mirror – Section – Assembly v Couplings – Flange, Universal, Oldham's, Muff, Gear couplings v Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch v Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump

The above tasks can be performed manually and using standard commercial 2D / 3D CAD software

**OUTCOMES:**

Upon the completion of this course the students will be able to

CO1 Follow the drawing standards, Fits and Tolerances

CO2 Re-create part drawings, sectional views and assembly drawings as per standards

TEXT BOOK:

1. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013

REFERENCES:

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers,2013

2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004

3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing" , published by Tata Mc GrawHill,2006 4. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

## CH - 2209 : ENVIRONMENTAL SCIENCE

**Course Objectives:**

* The aim of this course is to make the students better understand the changes in the environment and be given a greater voice and planning conservation through an interdisciplinary environmental science curriculum that is design to enhance scientific enquiry and to strengthen competence.

**Course Outcomes:**

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

* Understand various types of pollution regulations and their scientific bases.

* Apply knowledge for the protection and improvement of the environment.

* Recognize the major concepts in environmental science and demonstrating in-depth of the environment

## SYLLABUS

**Introduction:** Definition, scope and importance, measuring and defining environmental development – indicators.

**Ecosystems:** Introduction, types, characteristic features, structure and functions of ecosystems – forest, grassland, desert, aquatic (lakes, rivers and estuaries).

**Environmental and Natural Resources Management:** Land resources-land as a resource, common property resources, land degradation, soil erosion and desertification, effects of modern agriculture, fertilizer-pesticide problems.

**Forest Resources:** use and over-exploitation, mining and dams –their effects on forest and tribal people,

**Water Resources:** use and over utilization of surface and ground water, floods, droughts, water logging and salinity, dams-benefits and costs, conflicts over water,

**Energy Resources:** Energy needs, renewable and non-renewable energy sources, use of alternate energy sources, impact of energy use on environment,

**Bio-diversity and its Conservation:** Value of bio-diversity- consumptive and productive use, social, ethical, aesthetic and option values, bio-geographical classification of India - India as a mega diversity nation, threats to biodiversity, hot spots, habitat loss, poaching of wild life, loss of species, seeds etc., conservation of biodiversity - in-situ and ex-situ conservation,

**Environmental pollution- local and global issues**: Causes, effects and control measures of air pollution, indoor air pollution, water pollution, soil pollution, marine pollution, noise pollution, solid waste management, composting, vermiculture, urban and industrial wastes, recycling and re-use, nature of thermal pollution and nuclear hazards, global warming, acid rain , ozone depletion,

**Environmental problems in India**: Drinking water, sanitation and public health, effects of activities on the quality of environment, urbanization, transportation, industrialization, green revolution, water scarcity and ground water depletion, controversies on major dams – resettlement and rehabilitation of people: problems and concerns, rain water harvesting, cloud seeding and watershed management,

**Economy and environment**: The economy and environment interaction, economics of development, preservation and conservation, sustainability: theory and practice, limits to growth, equitable use of resources for sustainable lifestyles, environmental impact assessment,

**Social issues and the environment**: Population growth and environment, environmental education, environment movements, environment versus development,

**Institutions and governance**: Regulation by Government, monitoring and enforcement of environmental regulation, environmental Acts, water (prevention and control of pollution) act, air (prevention and control of pollution) act, environment .protection act, wild life protection act, forest conservation act, coastal zone regulations, institutions and policies relating to India, environmental governance,

**International conventions**: Stockholm conference-1972, Earth summit-1992, World commission for environmental development (WCED),

**Case studies**: Chipko movement, Narmada bachao andolan, Silent valley project, Madhura refinery and Taj mahal, Industrialization of Pattancheru, Nuclear reactor at Nagarjuna sagar, Tehri dam, Ralegaon siddhi (Anna Hazare), Kolleru lake-aquaculture, Fluorosis in Andhra Pradesh,

**Field work**: Visit to a local area to document and mapping environmental assets –river/forest/grass land / hill/ mountain, study of local environment-common plants, insects, birds, study of simple ecosystems – pond, river hill, slopes etc, visits to industries- water treatment plants, effluent treatment plants.

Text Book:

Environmental Studies by Anubha Kaushik & C.P. Kaushik, Second Edition, New Age International (P) Limited.

## B. Tech. CHEMICAL ENGINEERING

SCHEME AND SYLLABI (with effect from 2022-23)

## B.Tech. (Biotechnology)

***I Year - I Semester***

| Course code | Category | Course Title | Hours per week L | T | Internal Marks | External Marks | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|
| BT-1101 | BS | Maths – I | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1102 | BS | Physics | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1103 | ES | Biochemistry | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1104 | ES | Biology | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1105 | ES | Microbiology | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1106 | ES | Biochemistry LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| BT-1107 | BS | Physics Lab | 0 | 3 | 50 | 50 | 100 | 1.5 |
| BT-1108 | ES | Microbiology Lab | 0 | 3 | 50 | 50 | 100 | 1.5 |
| | | Total Credits | | | | | | 19.5 |

***I Year - II Semester***

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BT-1201 | BS | Maths – II | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1202 | BS | Green Chemistry | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1203 | HSS | English | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1204 | ES | CPNM | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1205 | ES | Industry 4.0 | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-1206 | HSS | English Language Lab | 0 | 3 | 50 | 50 | 100 | 1.5 |
| BT-1207 | BS | Green Chemistry Lab | 0 | 3 | 50 | 50 | 100 | 1.5 |
| BT-1208 | ES | CPNM Lab | 0 | 3 | 50 | 50 | 100 | 1.5 |
| | | Total Credits | | | | | | 19.5 |

***II Year - I Semester***

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BT-2101 | BS | Plant cell and tissue culture | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2102 | PC | Immunology | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2103 | PC | Bio-analytical Techniques | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2104 | PC | Downstream Processing | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2105 | HSS | Managerial Economics | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2106 | PC | Plant cell and tissue culture LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| BT-2107 | PC | Bio-analyticalTechniques LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| BT-2108 | PC | Downstream Processing LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| BT-2109 | SC | MATLAB (Software) | 1 | 2 | 50 | 50 | 100 | 2 |
| BT-2110 | MC | Professional Ethics & Universal Human values | 0 | 0 | - | 100 | 100 | 0 |
| BT-2111 | MC | NCC/NSS | 0 | 2 | - | - | - | 0 |
| | | Total Credits | | | | | | 21.5 |

***II Year - II Semester***

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BT-2201 | ES | Genetics | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2202 | BS/PC | Material and Energy Balances | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2203 | PC | Fluid Mechanics and Particle Technology | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2204 | PC | Biochemical Thermodynamics | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2205 | PC | Python Programming | 4 | 0 | 30 | 70 | 100 | 3 |
| BT-2206 | PC | Fluid Mechanics and Particle Technology LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| BT-2207 | PC | Python Programming LAB | 0 | 3 | 50 | 50 | 100 | 1.5 |
| BT-2208 | SC | Biostatistics | 1 | 2 | 50 | 50 | 100 | 2 |
| BT-2209 | MC | Environmental Science | 0 | 0 | - | 100 | 100 | 0 |
| | | Total Credits | | | | | | 20 |

Internship-I

### BT-1101 : MATHEMATICS - I

***Course Objectives:***

* To transmit the knowledge of Partial differentiation.

* To know of getting maxima and minima of function of two variables and finding errors and approximations.

* To evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

***Course Outcomes:***

* Find the partial derivatives of functions of two or more variables.

* Evaluate maxima and minima, errors and approximations.

* Evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

* Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

## SYLLABUS

**Partial Differentiation:** Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobins. Mean value Theorems (without proofs).

**Applications of Partial Differentiation:** Geometrical interpretation -Tangent plane and Normal to a surface -Taylor's theorem for functions of two variables - Errors and approximations -Total differential. Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz's rule.

**Multiple Integrals:** Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

**Multiple Integrals-Applications:** Area enclosed by plane curves - Volumes of solids - Area of a curved surface - Calculation of Mass - Center of gravity - Moment of inertia - product of inertia – principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions. Error Function or Probability Integral.

**Fourier Series:** Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula. Practical Harmonic analysis.

*Text Book:*

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd Edition, Khanna publishers.

*Reference Books:*

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K.International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

6. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

## BT-1102 : PHYSICS

***Course Objectives:***

* To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.

* To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultrasonics and their applications in engineering.

* To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.

* To Learn basics of lasers and optical fibers and their use in some applications.

* To Understand concepts and principles in quantum mechanics and Nanopahse Materials. Relate them to some applications.

***Course Outcomes:***

* Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.

* Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications .

* Understand the Theory of Superposition of waves. Understand the formation of Newton's rings and the working of Michelson's interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due to a single slit

* Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fiber communication.

* Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one Dimensional Schrodinger's wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

## SYLLABUS

**Thermodynamics:** Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

**Electromagnetism:** Concept of electric flux, Gauss's law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

**Ultrasonics :** Introduction, Production of Ultrasonics – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultrasonics.

***OPTICS***

**Interference:** Principles of superposition – Young's Experiment – Coherence - Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications.

**Diffraction:** Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit (Qualitative and quantitative treatment).

**Polarisation:** Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

**Lasers And Fibre Optics:** Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers Introduction to optical fibers, principle of propagation of light in optical fibers, Acceptance Angle and cone of a fibre, Numerical aperture, Modes of propagations, classification of fibers, Fibre optics in communications, Application of optical fibers.

**Modern Physics:** Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi conductors and insulators.

**Nanophase Materials:** Introduction, properties, Top-down and bottom up approaches, Synthesis - Ball milling, Chemical vapour deposition method , sol-gel methods, Applications of nano materials.

*Text Books :*

1. Physics by David Halliday and Robert Resnick – Part I and Part II - Wiley.

2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand

3. Engineering Physics by R.K. Gaur and S.L. Gupta –Dhanpat Rai

*Reference Books:*

1. Modern Engineering Physics by A.S. Vadudeva

2. University Physics by Young and Freedman

## BT-1103 : BIOCHEMISTRY

***Course Objectives:***

* To study about the principles and significance of biochemistry.

* To study about the structure and function of Carbohydrates, Proteins and Aminoacids and Lipids.

* To study about the Nucleic acids like DNA and RNA and also to study about the structure and function of enzymes.

* To study about haemoglobin and chlorophyll molecules and their functions.

* To study about the fat soluble and water soluble vitamins also to study about the structure and function of harmones.

***Course Outcomes:***

At the end of the course, the students would be able to

* Define Biochemistry- study of chemical reactions and processes in living systems

* Understand Carbohydrates, Proteins and Amino acids and Lipids.

* Differentiate quantitative and qualitative analysis of the bio molecules.

* Demonstrate nucleic acids-DNA and RNA hereditary materials and enzyme structure and functions.

* Explain the basic structure of porphyrins and the detailed structure of haemoglobin and chlorophyll molecules.

* Describe the structure and function of vitamins and endocrinal glands.

## SYLLABUS

Scope and importance of Biochemistry.

**Carbohydrates:** Classification, chemistry and properties of monosaccharides (Ribose, Glucose, and Fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (homopolysaccharides and heteropoly saccharides), metabolism of carbohydrates - glycolysis,

TCA cycle, electron transport and oxidative phosphorylation, HMP shunt pathway, glycogenesis and glycogenolysis,

**Proteins and amino acids:** Classification and properties of amino acids and proteins, peptide bond, chemical synthesis of peptides and solid-phase peptide synthesis, structural organization of proteins- primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins,

**Lipids:** Classification, structure and physiological functions of triglycerides, fatty acids, phospholipids, cerebrosides, gangliosides and cholesterol, digestion and absorption of fats, biosynthesis and degradation of fatty acids and triglycerides,

**Nucleic acids:** Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides, cellular localization, isolation and estimation of nucleic acids, types of nucleic acids, double helical structure of DNA, types of RNA, biosynthesis and catabolism of purines and pyrimidines,

**Enzymes:** Introduction, nomenclature and classification of enzymes, kinetic properties of enzymes, factors affecting enzyme action, coenzymes, enzyme inhibition- competitive, non- competitive and uncompetitive inhibitions,

**Porphyrins:** Chemistry of hemoglobin and chlorophyll, synthesis of heme and chlorophyll and heme catabolism,

**Vitamins and hormones:** Definition, classification, chemistry, source, functions and deficiency of vitamins, outlines of hormones and their functions,

*Text Books:*

1. "Fundamentals of Biochemistry" by J.L.Jain, S.Chand& Company Ltd, New Delhi

2. "Principles of Biochemistry" by Lehninger, Nelson and Cox, CBS Publications.

## BT-1104 : BIOLOGY

***Course Objectives:***

* To study about the cell structure and function.

* To study about the plant structure, functions of various cells in the plants, flower

* structure, pollination and fertilization.

* To study about the physiological processes in the plant and various methods of plant

* breeding techniques.

* To study about the general characters of animals- invertebrates, vertebrates.

* To study about the general physiological processes like digestion, respiration, and

* excretion etc of the animals.

***Course Outcomes:***

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

* Obtain knowledge in the biological processes occurring in the cells.

* Make use of structure of plants, and understand the phenomena of Embryology so that

* they produce new varieties of plants.

* Analyze various physiological processes of the plants in plant breeding techniques.

* Understand the general characters of animals, the phenomena of reproduction and life

* cycle of plasmodium vival.

* Illustrate various physiological processes of the animals. Digestion, respiration

* Excretory system, Nervous system functions are understood to the student so that

* student can do research in their future studies.

### SYLLABUS

**Cell Biology:** Structure and function of prokaryotic and eukaryotic cell, cell organelles, cell membrane, chloroplast, mitochondria, golgi complex, endoplasmic reticulum, lysosomes, ribosomes and nucleus, chromosome structure, mitosis and meiosis,

**Plant Biology:** Parts of a flowering plant; flower-structure of a typical flower, outline description of floral parts – androecium, gynoecium,

**Embryology:** Structure of anther, microsporogenesis and development of male gametophyte, structure of ovule, megasporogenesis, development of embryo sac. fertilization, process of fertilization and post fertilization changes,

**Anatomy:** Structure and function of xylem and phloem, internal structure of dicot root, stem and leaf, monocot root, stem and leaf, secondary growth of dicot stem,

**Plant Physiology:** Water relations of plants, absorption of water by plants, diffusion, water potential, osmosis, plasmolysis, imbibition, active and passive absorption,

**Mineral nutrition:** Criteria for essentiality, macro elements (nitrogen, phosphorus and potassium) and microelements,

**Photosynthesis:** photosynthetic pigments, light reaction-Emerson enhancement effect, photo system I and II, photolysis of water, photophosphorylation, $CO_2$ fixation – C3, C4 and CAM pathway, photorespiration, factors affecting photosynthesis – Blackman's law of limiting factors,

**Nitrogen metabolism:** Introduction, nitrogen cycle, biological nitrogen fixation, Plant Growth Regulators: Auxins, gibberellins, cytokinins, abscisic acid and ethylene,

**Plant Breeding:** Methods of plant breeding: selection, hybridization, hybrid vigor and mutational breeding,

**Animal Biology:** General characters of invertebrates, morphology, life cycle and reproduction of Plasmodium Vivax, general characters of vertebrates.

**Animal Physiology:** Animal nutrition- modes of nutrition, digestive system of humans and accessory digestive organs, gastrointestinal secretions, digestion, absorption and assimilation of digested products, egestion,

**Respiration:** Respiration in humans – respiratory system, mechanism of respiration,

**Circulatory system:** Blood vascular system in humans, blood and its components, heart, pumping action of heart, heart beat and pulse, important blood vessels and course of blood circulation, lymphatic system-lymph, lymph vessels, lymph nodes and lymphatic ducts and pacemakers,

**Excretion:** Elimination of nitrogenous waste- ammonotelic, ureotelic and uricotelic, structure of human excretory system, structure of urinary system, anatomy of kidney, and structure of nephron,

**Nervous system:** Structure of neuron, nerve impulse and its conduction, synapse, central nervous system- lobes of brain and its meninges, spinal cord, Peripheral nervous system- Cranial nerves and spinal nerves, autonomous nervous system, sympathetic and parasympathetic nervous system, reflex action, reflex arch of humans.

*Text Books:*

1. 'Biology Text Book for class XI and XII', NCERT.

2. 'AP Academy Text Book for Botany and Zoology, for intermediate

## BT-1105 : MICROBIOLOGY

***Course objectives:***

* To make the student learn about origin and evolution of microbes.

* To make the student understand structure and functioning of different microbial

* groups.

* To make them to acquaint the cultivation of microbes in artificial medium.

***Course Outcomes:***

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

* Demonstrate the origin and evolution of microbes

* Understand structure and functioning of different microbial groups.

* Understand the importance of microbes in ecosystem

* Explain why microorganisms are ubiquitous in nature, inhabiting a multitude of

* habitats and occupying a wide range of ecological habitats.

### SYLLABUS

**History and Development of Microbiology:** Contributions of van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck, further developments of microbiology,

**Microbial Taxonomy:** Bacteria, archea and their broad classification. Molecular approaches to microbial taxanomy, physiology of extremophiles, Morphology and Functions of Viruses, Yeast, Molds and Bacteria:

**Viruses**-Morphology of viruses- size, shape and symmetry, replication of viruses- Lytic and Lysogenic cycle,

**Yeast and Molds:** Morphology, life cycle, economic importance of yeast and Aspergillus,

**Bacteria:** Ultra structure of bacteria, cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell,

**Microbial growth:** Definition of growth- growth curve, measurement of bacterial growth (cell number and cell mass ) growth yield, continuous culture-chemostat, turbidostat, synchronous growth, effect of environmental factors on growth,

**Microbial Nutrition and Control of Microorganisms**: Nutritional requirements, nutritional types of bacteria, up-take of nutrients by cell, sterilization, and disinfection, effect of physical (moist and dry heat, radiation and filtration) and chemical agents, antibiotics- mode of action and resistance,

**Methods in Microbiology:** Culture media, synthetic and complex media, solidifying agents, types of media, isolation of pure cultures- spread plate, pour plate and streak plate, preservation of microorganisms, light (bright field only) and electron microscopy,

**Applied Microbiology:** Water, food and milk born contamination and remedy; basic microbial genetics- transformation, conjugation, transduction, strain improvement of industrially important micro-organisms.

*Text Book:*

'Microbiology', by Prescott L.M., Herley J.P., Klein D.A., McGraw- Hill

*Reference Books:*

1. "Microbiology", Pelzar, M.J., Chan, E.C.S., Kreig N.R., Tata McGraw-Hill

2. "Brock biology of Microorganisms", Madigan M.T.,Martinco J.M. and Parker J., Prentice Hall

## BT-1106 : BIOCHEMISTRY LABORATORY

***Course objectives:***

* This lab has been designed for the better understanding of biochemistry and to estimate the amount of biomolecules from biological substances and to prepare the buffers required to conduct laboratory sampling & testing. Further this lab also fulfills the Skills required in various biotechnology & food processing industries.

***Course out comes:***

* At the end of the course, the students will achieve the following out comes.

* Gains good knowledge & skills in biochemistry field for better understanding Biomolecules & biochemical techniques.

* Prioritise Biochemistry related experiments in the research field of Biotechnology.

* Able to handle various instruments related to biochemistry.

* In the industry and in the scientific laboratory, professionally can do work independently.

* Develop the knowledge to extract, estimate the biomolecules and report the data in the field of biochemistry & biotechnology research.

***List of Experiments:***

1. Preparation of Acetate Buffer
2. Preparation of Phosphate Buffer
3. Estimation of glycine by Sorenson's formal method .
4. Estimation of Reducing sugar with Benedicts Quantitative Reagent.
5. Preparation of calcium alginate beads.
6. Paper chromatography technique to separate biomolecules.
7. Estimation of glucose using 3,5- dinitrosalicylic acid ( DNS) method.
8. Estion of total carbohydrates using anthrone method.
9. Estimation of proteins using Lowry method.
10. Estimation of proteins using biuret method

## BT-1107 : PHYSICS LAB

***Course Objectives:***

* To enable the students to acquire skill, technique and utilization of the Instruments

* Draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.

* To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.

* To familiarize the handling of basic physical apparatus like Vernier callipers, screw gauge, spectrometers, travelling microscope, laser device, optical fibre, etc.

***Course Outcomes:***

* Ability to design and conduct experiments as well as to analyze and interpret

* Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics

* The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

### SYLLABUS

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton's Rings.
2. Determination of Wavelength of Spectral Lines in the Mercury Spectrum by Normal Incidence method.
3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.
4. Determination of Cauchy's Constants of a Given Material of the Prism using Spectrometer.
5. Determination of Refractive Index of Ordinary ray m---$_o$ and Extraordinary m---$_e$ ray.
6. Determination of Thickness Given Paper Strip by Wedge Method.
7. Calibration of Low Range Voltmeter.
8. Calibration of Low Range Ammeter.
9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.
10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.
11. Carey Foster's Bridge – Verification of laws of Resistance and Determination Of Specific Resistance.
12. Melde's Apparatus – Frequency of electrically maintained Tuning Fork.
13. Photoelectric cell-Characteristics.
14. Planks Constants.
15. Laser- Diffraction.

## BT-1108 : MICROBIOLOGY LAB

***Course objectives:***

* To provide the basic fundamental knowledge on growth of microorganisms

* To provide the basic fundamental knowledge on reaction of microorganisms with

* specific growth media

* To understand biochemical reactions with media used in identification.

***Course outcomes:***

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

* Explain the handling microbes and basic instrumentation used in Microbiological laboratory.

* Evaluate the growth and reaction of microorganisms on specific media

* Understand the staining and motility of microbes

* Differentiate the morphology of Fungi and yeast

* Evaluate quality of milk and water

***List of Experiments:***

1. Preparation of Nutrient broth and inoculation of Bacteria.
2. Preparation of Nutrient agar and inoculation of Bacteria
3. Isolation of pure cultures
4. Staining of Microbes- Simple staining, Gram staining, Negative staining, Capsule staining and spore staining.
5. Motility of Microbes.
6. Morphology of Fungi-( Aspergillusniger)
7. Morphology of Yeast-( Saccharomyces cerevisiae )
8. Bio-chemical tests- IMViC test, Amylase test, Hydrogen Sulphide production test
9. Testing of Microbiological quality of milk.
10. Testing of Microbiological quality of water.
11. Microbial assay of antibiotics.
12. Evaluation of disinfectant.

*Text Book:*

'Microbiology- a Laboratory Manual' by Cappuccino T.G., Sherman N, Addison

## BT-1201 : MATHEMATICS – II

***Course Objectives:***

* The way of obtaining rank, eigen values and eigen vectors of a matrix.

* To know the importance of Cayley-Hamilton theorem and getting canonical form from a given quadratic form.

* To solve the system of equations by using direct and indirect methods.

* To solve first order and higher order differential equations by various methods.

* To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

***Course Outcomes:***

* Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.

* Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.

* Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling

* Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.

* Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

### SYLLABUS

**Linear Algebra:** Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination method, LU Factorization method, Gauss Seidal Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

**Eigen Values and Eigen Vectors:** Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

**Ordinary Differential Equations of First Order and its Applications:** Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations - Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton's Law of Cooling - Law of Natural growth and decay.

**Differential Equations of Higher Order:** Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear differential equations.

**Laplace Transforms:**Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by $t^n$ - Division by t – Evaluation of integrals by Laplace Transforms - Inverse Laplace Transform - Applications of Laplace Transforms to Ordinary Differential Equations - Simultaneous Linear Differential Equations with Constant Coefficients - Second Shifting Theorem - Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

*Text Book:*

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd edition, Khanna publishers.

*Reference Books:*

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

## BT-1202 : GREEN CHEMISTRY

## SYLLABUS

***Course Objectives:***

CO 1: To apply the basic knowledge of Chemistry to the Engineering Discipline.

CO 2: To develop knowledge about water and its treatment for industrial and potable purposes.

CO 3: To develop understanding in the areas of Batteries, Fuels Mechanism of Corrosion of Metals and Corrosion Control Methods, Green Chemistry and Technology and Processes involving Green Chemistry and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

**Learning outcome:**

LO 1: The students are able to apply the basic concepts and principles studied in Chemistry to the field of Engineering.

LO 2: The students are able to apply chemistry to different branches of engineering

LO 3: The students are able to acquire the knowledge in the areas of Water Chemistry, Mechanism of Corrosion of Metals and Corrosion Control Methods, Batteries, Fuel Cells, Green Chemistry and Technology and Processes involving Green Chemistry and suggest innovative solutions for existing challenges in these areas.

Unit 1: Water Technology : Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Unit 2: Batteries : Primary batteries: The chemistry - Types: Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells – liquid cathode, solid cathode and lithium-ferrous sulphide cells. Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells. Advanced Batteries for electric vehicles, requirements of the battery – sodium-beta and redox batteries.

Unit 3: Fuel Cells : Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells- Membranes and Fuels

Unit 4: Corrosion : **Corrosion:** Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting, Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion. Corrosion Controlling Methods, Protective Coatings, Metallic Coatings, Electroplating and Electroless Plating.

Unit 5: Green Chemistry and Technology : Introduction and significance of green chemistry, Goals of green chemistry, 12 principles of green chemistry, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, functional group approaches to green chemistry, Elimination of toxic functional group, optimization of frameworks for the design of greener synthetic pathways, Applications of green chemistry - Green solvents, green fuels and propellants, biocatalysis.

Text Books

1. Engineering Chemistry – PC Jain and M. Jain – Dhanpath Rai and Sons, New Delhi.

2. A Text book of Engineering Chemistry – S. S. Dara – S. Chand & Co. New Delhi.

3. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.

## BT-1203 : ENGLISH

**Course Objectives:**

* To make students understand the explicit and implicit meanings of a text/topic;

* To give exposure to new words and phrases, and aid to use them in different contexts;

* To apply relevant writing formats to draft essays, letters, emails and presentations; and

* To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

**Course Outcomes:**

* Students will be able to analyse a given text and discover the various aspects related to language and literature;

* Learn the various language structures, parts of speech and figures of speech;

* Develop one's reading and writing abilities for enhanced communication; and

* Learn to apply the topics in real-life situations for creative and critical use.

### SYLLABUS

On the conduct of life: William Hazlitt

**Life skills: Values and Ethics**

If: Rudyard Kipling

The Brook: Alfred Tennyson

Life skills: Self-Improvement

How I Became a Public Speaker: George Bernard Shaw

The Death Trap: Saki

Life skills: Time Management

On saving Time: Seneca

Chindu Yellama

Life skills: Innovation

Muhammad Yunus

Politics and the English Language: George Orwell

Life skills: Motivation

Dancer with a White Parasol: Ranjana Dave

Grammar: Prepositions – Articles – Noun-Pronoun Agreement, Subject-Verb Agreement – Misplaced Modifiers – Clichés, Redundancies.

Vocabulary: Introduction to Word Formation – Root Words from other Languages – Prefixes and Suffixes – Synonyms, Antonyms – Common Abbreviations

Writing: Clauses and Sentences – Punctuation – Principals of Good Writing – Essay Writing – Writing a Summary

**Writing:** Essay Writing

Life skills: Innovation

Muhammad Yunus

Text Book:

Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India. 2018.

References Books :

1. Practical English Usage, Michael Swan. OUP. 1995.

2. Remedial English Grammar, F.T. Wood. Macmillan.2007

3. On Writing Well, William Zinsser. Harper Resource Book. 2001

4. Study Writing, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

5. Communication Skills, Sanjay Kumar and PushpLata. Oxford University Press. 2011.

6. Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

## BT-1204 : 'C'-Programing and Numerical Methods

**Course Objectives:**

* The course is designed to provide complete knowledge of C language.

* To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

* To provide knowledge to the Students to develop logics which will help them to create programs, applications in C.

* This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

* This course provides the fundamental knowledge which is useful in understanding the other programming languages.

**Course Outcomes:**

* Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and Apply them in problem solving.

* Apply various operations on derived data types like arrays and strings in problem solving.

* Design and Implement of modular Programming and memory management using Functions, pointers.

* Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.

* Apply Numerical methods to Solve the complex Engineering problems.

## SYLLABUS

**Introduction to C:** Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

**Decision Making, Branching, Looping, Arrays & Strings:** Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else..if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops ,One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

**Functions:** Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

**Pointers:** Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications

**Structure and Unions:** Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

**File handling:** Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments- Program Applications

**Numerical Methods:** Solutions of Algebraic and Transcendental Equations, Bisection Method, Newton Raphson Method. Newton's forward and backward Interpolation, Lagrange's Interpolation in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules. Solutions of Ordinary First Order Differential Equations: Euler's Method, Modified Euler's Method and Runge-Kutta Method.

Text Book:

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India) Private Limited.

2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

Reference Books:

1. Let Us C ,YashwantKanetkar, BPB Publications, 5th Edition.

2. Computer Science, A structured programming approach using C", B.A.Forouzan and R.F.Gilberg, " 3rd Edition, Thomson, 2007.

3. The C –Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.

4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Enzo Marinari (Author), Giovanni Organtini, World Scientific.

## BT-1205 : INDUSTRY 4.0

## SYLLABUS

Unit-1: Introduction to Industry 4.0 : Introduction, Idea of Industry 4.0, Various Industrial Revolutions, Origin concept of Industry 4.0,Industry 4.0 Production system, How is India preparing for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory.

Unit-2: Trends in Industry 4.0 : Introduction, Main Concepts and Components of Industry 4.0, State of Art Technologies, Proposed Framework for Industry 4.0, Trends of Industrial Big Data and Smart Business Transformation.

Unit-3: Roadmap for Industry 4.0 : Introduction, Proposed Framework for Technology Roadmap: Strategy Phase, Development Phase, Smart Manufacturing, Types of Smart Devices, Smart Logistics, Smart Cities, Predictive Analytics.

Unit-4: Advances in the Era of Industry 4.0 : Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Things, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly, IIoT- Industrial IoT.

Unit-5: The Role of Industry 4.0 and Future Aspects : Introduction, Challenges & Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

**(MATERIAL IS READILY AVAILABLE ON INTERNET)**

## BT-1206 : ENGLISH LANGUAGE LAB

**Course Objectives:**

* To make students recognize the sounds of English through Audio-Visual aids;

* To help students build their confidence and help them to overcome their inhibitions and self- consciousness while speaking in English;

* To familiarize the students with stress and intonation and enable them to speak English effectively; and

* To give learners exposure to and practice in speaking in both formal and informal contexts.

**Course Outcomes:**

* Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;

* A study of the communicative items in the laboratory will help students become successful in the competitive world;

* Students will be able to participate in group activities like roleplays, group discussions and debates; and

* Students will be able to express themselves fluently and accurately in social as well professional context.

### SYLLABUS

**Introduction to Phonetics:** The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

**Listening Skills:** Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

**Speaking Skills:** Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

**Reading and Writing skills:** Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

**Presentation skills:** Verbal and non-verbal communication - Body Language - Making a Presentation.

Reference Books:

1. Ashraf Rizvi. Effective Technical Communication. Tata McGraw Hill Education Private Limited, New Delhi.

2. Speak Well. Orient Blackswan Publishers, Hyderabad.

3. Allan Pease. Body Language. Manjul Publishing House, New Delhi.

## BT-1207 : GREEN CHEMISTRY LAB

**Course Objectives:**

CO 1:To develop the fine skills of quantitative determination of various chemical components through
titrimetric analysis
CO 2:To prepare ion exchange/ zeolite column for removal of hardness
CO 3:To develop the skill of green synthesis through the preparation of a polymer/ drug

**Learning Outcomes:**

LO 1: The students are able to determine the amount of various chemical species in solutions by titrations quantitatively with accuracy
LO 2: The students are able to develop novel materials to be used as zeolite and prepare columns for removal of hardness of water
LO 3: The students develop skills to synthesise a polymer or a drug

### SYLLABUS

1. Determination of Sodium Hydroxide with HCl ($Na_2CO_3$ Primary Standard)

2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample

3. Determination of percentage of Iron in the given rust solution by external indicator method

4. Determination of total Hardness of Water sample by EDTA method

5. Preparation and analysis of Ionexchange/ Zeolite column for removal of hardness of water

6. Green Synthesis of Polymer/ drug

Reference Books:

1. Vogel's Quantitative Chemical Analysis – V – Edition – Longman.

2. Experiments in Applied Chemistry (For Engineering Students) – Sinita Rattan – S. K. Kataria & Sons, New Delhi

## BT-1208 : CPNM LAB

**Course Objectives:**

* To impart writing skill of C programming to the students and solving problems.

* To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,

* To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.

* This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

**Course Outcomes:**

* Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.

* Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.

* Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.

* Apply and practice logical ability to solve the real world problems.

* Apply Numerical methods to Solve the complex Engineering problems.

## SYLLABUS

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?

2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while).

3. Write a set of string manipulation functions e.g. for getting a substring from a given position, Copying one string to another, Reversing a string, adding one string to another.

4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?

5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.

6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).

7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.

8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.

9. Implement bisection method to find the square root of a given number to a given accuracy.

10. Implement Newton Raphson method to det. a root of polynomial equation.

11. Given table of x and corresponding f(x) values, Write a program which will determine f(x) value at an intermediate x value by using Lagrange's interpolation

12. Write a function which will invert a matrix.

13. Implement Simpson's rule for numerical integration.

14. Write a program to solve a set of linear algebraic equations.

## BT-2101 : PLANT CELL AND TISSUE CULTURE

**Course Objectives:**

* To know the basics of plant tissue culturing.

* To know the production of callus from carrot.

* To measure the efficacy of root and shoot.

* To develop the graduate capabilities of knowledge ability, comprehension and applications of plants in cell and tissue culture systems.

* To know how cell and tissue culture contributes to global sustainability.

* To develop the practical skills and confidence of students to successfully culture plant cells and tissues.

**Course Outcomes:**

At the end of the course, students will be able to:

* Explain the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what governs the choice of components

* Describe the various steps taken to establish and optimize media for particular purposes in particular species, without the aid of texts.

* Demonstrate and perform some of the more advanced techniques, e.g. embryo rescue, and protoplasting.

* Establish and maintain plants in tissue culture and micropropagation, including morphogenesis.

* Understand the various cell lines used in tissue culture and their origins and uses.

## SYLLABUS

**Fundamentals of plant tissue culture:** laboratory organization, sterilization methods, culture medium and growth regulators. Totipotency, callus culture and organogenesis- Expression of totipotency in cell culture and importance; Principle of callus culture, characteristics of callus culture and importance; Principle of organogenesis, factors effecting organogenesis and applications.

**Cell culture:** single cell culture-isolation, methods of single cell culture and importance; Cell suspension culture, types of suspension culture, growth pattern, synchronization, assessment of growth and viability of cultured cells, significance of suspension cultures.

**Somatic embryogenesis and synthetic seeds:** principle, induction of embryogenesis, embryo development and maturation, factors effecting somatic embryogenesis, synchronization, large scale production and importance of Somatic embryogenesis, synthetic seeds- methods of making synthetic seeds and applications.

Germplasm conservation Somoclonal variations – its genetic basis and application in crop improvement- cell line selection for resistance to herbicides, stress and diseases. Haploid production and its advantages- androgenesis, principle, pollen culture, advantages of pollen culture over anther culture, homozygous diploids, importance of anther and pollen culture. Clonal propagation –technique- multiplication by axillary and apical shoots, adventitious buds/bulbs/protocorms, by callus culture, transplantation, acclimatization Production of disease free plants- meristem tip culture- virus indexing.

Protoplast technology- isolation, culture and plant regeneration, protoplast fusion, methods, identification and characterization of somatic hybrids, cybrids and importance of somatic hybridisation.

Genetic transformation – plant vectors – Ti plasmids, Ri plasmids - indirect and direct methods, current status and limitations. Automation and Economics of tissue culture.

Text Book:

Plant tissue culture – Kalyan Kumar De – New Central Book Agency

Reference Books:

1. An Introduction to Plant tissue culture. Razdan. M. K., Oxford & LBH.
2. Plant tissue culture- theory and practice. Bhojwani, SS &Razdan, MK.Elsevier
3. Plant tissue and Cell culture. Street, HE.Blackwell

## BT-2102 : IMMUNOLOGY

**Course Objectives:**

To study about the process of immunity and organs and cells of lymphoid system.

* To study about the properties of antigens and structure and function of antibodies and various reactions of antigen and antibody.

* To study about complement system, major histocompatibility and various immune responses.

* To study about the hypersensitive reactions and their role in graft rejection and to study transplantation and various auto immune diseases.

* To study the hybridoma technology and to study the various vaccines and vaccination process.

**Course Outcomes:**

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

* Understand immunology, the structure and function of lymphoid organs and cells.

* Explain the process of antigenecity, and in the production of antibodies

* Describe precipitation, agglutination, and other antigen-antibody reactions so that student will become a good immunologist.

* Explain complement system and immune response –humoral and cell mediated and MHC (Majorhistocompatibility).

* Understand hypersensitive reactions, organ transplantations and various auto immune diseases.

* Demonstrate fusion of cells to produce hybrid cells (Hybridoma technology), Understand the method of vaccination.

## SYLLABUS

**Immunity, Lymphoid organs and cells:** Introduction to Immunology and its origin in vertebrates and invertebrates, immunity-innate immunity and acquired immunity and the various lines of defence, organs of immune system, Thymus, bone marrow, bursa of fabricius, spleen, lymphnode and MALT, cells of immune system- B-cells, T-cells, antigen presenting cells, monocytes, NK cells and langerhan cells,

**Antigens, Antibodies and Ag-Ab reactions:** Antigens- properties of antigens, haptens, epitopes, T-dependent and T-independent antigens, adjuvants and their clinical importance, immunoglobulins- classification, structure and functions of immunoglobulins, antigenic determinants on antibodies, antigen – antibody reactions, and tests involving them - precipitation tests, agglutination tests, complement fixation tests, immunofluorescence, RIA, ELISA, Western blotting and ELISPOT,

**Complement, MHC and Immune response:** Complement system- its components, complement fixation pathways and consequences, MHC- In mice and human, structure of MHC molecules and their role in antigen presentation, immune response- humoral and cell, mediated immune response, IR

curve, role of cytokines in immunity, interferons and interleukins, immune suppression, immune tolerance,

**Hypersentivity, Transplantation, Autoimmune disease:** Hypersensitive reactions- Type I, II, III and IV reactions and their role in graft rejection, transplantation immunology- classification of grafts and immunology of graft rejection, agents used for preventing graft rejection, autoimmune diseases- definition and few examples,

**Hybridoma and Vaccination:** Hybridoma technology- production of monoclonal antibodies and their applications, vaccines and vaccination, methods of attenuation of live forms, types of vaccines- whole organisms as vaccines, attenuated forms, purified molecules as vaccines, recombinant organisms, DNA vaccines and synthetic peptides.

Text Books:

1. 'Immunology' by A.Goldsby, Thomas J.Kindt, Barbara A.Osborne and Janis Kuby

2. 'A Text book of Microbiology' by R.Ananthanarayan and C.K.J.Pandey.

## BT-2103 : BIO-ANALYTICAL TECHNIQUES

**Course Objectives:**

* The course is designed to impart the knowledge in the field of Pharmaceutical Analysis. The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics will be taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation. In addition to theoretical aspects, the basic practical knowledge relevant to the analysis will also be imparted.

**Course Outcomes:**

At the end of the course, the students will be able to

* Explain general principles and theory of the Spectroscopy.

* Understand the basic instrumentation of HPLC, GLC for identification and characterization of compounds.

* Learn various separation techniques.

* Analyze instrumentation, separation and identification of compounds by Electrophoresis.

### SYLLABUS

Chromatographic Techniques - Affinity - Adsorption - paper - Thin layer - Column - Ion Exchange - Gel Chromatography - Applications.

Gas liquid chromatography - High Pressure liquid chromatography - Equipment - Applications.

Spectrophotometric Techniques - IR - UV - Visible - NMR - ESR - Optical density - Circular dichroism.

pH - pH titrations - Determination of pKa values - Buffers - Preparation - Buffer Action - Physiological buffers - potentiometric titration - centrifugal dialysis - lyophilization -

Electrophoresis - Ultra filtration - Assay techniques for proteins, lipids, sugars, amino acids and nucleic acids.

Text Books:

1. " Instrumental methods of Chemical Analysis - Chatwal, G & Anand, S. Himalaya Publishing House, Bombay.

2. "Instrumental methods of Chemical Analysis - Sharma, B.K. Goel Publishing House, Meerut.

3. "Instrumental Methods Analusis - Willard, Merritt, Dean& Settle, CBS Publishers & Distributors, Delhi.

## BT-2104 : DOWNSTREAM PROCESSING

**Course Objectives:**

The course will help to:

* Learn the fundaments of downstream processing

* Understand the principle, working and application of major unit operations in Bio processing of industrially important products.

* Understand strategies for development of novel Bio processing protocol by applying the concise principles of downstream processing.

**Course Outcomes**:

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

* Apply the concepts of downstream processing for separation.

* Execute precise and efficient bio separation process, which is cost effective and yield high degree of pure substance.

* Select the bio separation process which gives high resolution, economical bio products.

### SYLLABUS

**Cell Disruption**: Physical and Mechanical methods, Chemical and Enzymatic methods.

**Separation Of Insoluble Products**: Filtration, Centrifugation, Coagulation and Flocculation, Sedimentation.

**Separation Of Soluble Products**: Extraction, Precipitation, Adsorption, Micro filtration, Ultra-filtration,Reverse Osmosis,Dialysis, Electro Dialysis, Pervaporation. Electrophoresis, Gel Exclusion Chromatography and Ion Exchange Chromatography.

**Products Purification & Polishing**: Crystallizationand Drying.

Text Books:

1. "Bioseparations–principles & techniques" by B.Siva Sankar.

2. "Bioprocess Engineering" by Michael L.ShulerFikretKargi, Prentice Hall of India

3. "Bioseparations – downstream processing for Biotechnology", by Paul A Belter and E.L.Cussler.

Reference Books:

1. "Biochemical engineering fundamentals" 2nd ed. by J E Bailey and D Ollis, McGraw- Hill (1986).

2. "Principles' of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press (1984).

## BT-2105 : MANAGERIAL ECONOMICS

**Course Objectives:**

* To bring about an awareness about the nature of Managerial Economics and its linkages with other disciplines.

* To understand the Micro and Macro Environment of Business.

* To familiarise the prospective engineers with the concepts and tools of Managerial Economics with an objective to understand the real world of business.

**Course Outcomes:**

* Managerial Economics will help the prospective engineers, who are likely to occupy managerial positions in future to understand the various economic activities in business and industry for an effective and efficient running of the organizations.

## SYLLABUS

Significance of Economics and Managerial Economics:

**Economics:** Definitions of Economics- Wealth, Welfare and Scarcity definition Classification of Economics- Micro and Micro Economics.

**Managerial Economics:** Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

**Demand Analysis :Demand -** Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve.

**Elasticity of demand** - Definition, Measurement of elasticity, Types of Elasticity ( Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

**Demand Forecasting -** Need for Demand forecasting, Factors governing demand forecasting, Methods of demand forecasting: Survey methods- Experts' opinion survey method and consumers Survey methods.

**Utility Analysis:** Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations.

Theory of Production and Cost analysis:

**Production -** Meaning, Production function and its assumptions, use of production function in decision making; Law of Variable Proportions: three stages of the law.

**Cost analysis -** Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. unavoidable costs, Economies and Diseconomies of scale.

**Market Structures** : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve ;Monopolistic Competition.

**Pricing Analysis** : Pricing - Significance: Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark-down pricing of retailers.

Business cycles, Inflation and Deflation: **Business cycles** - Definition , Characteristics , Phases, Causes and Consequences; Measures to solve problems arising from Business cycles.

**Inflation -**Meaning, Types, Demand- pull and Cost push inflation, Effects of Inflation, Anti- inflationary measures.

**Deflation-** Meaning, Effects of Deflation, Control of Deflation, Choice between Inflation and Deflation.

Text Books:

1. Managerial Economics by Sankaran,S., Marghan Publications, 2015, Chennai.

2. Managerial Economics and Financial Analysis by Aryasri, A.R., MC Graw Hill Education, New Delhi, 2015.

## BT-2106 : PLANT CELL AND TISSUE CULTURE LABORATORY

**Course Objectives:**

* To acquaint students with the principles, technical requirement, scientific and commercial applications of Plant Tissue and Cell culture.

* To expose students to supporting methodologies of plant tissue and cell culture, micro propagation techniques and applications of Tissue and Cell culture to plant improvement.

**Course Outcomes:**

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

* Develop and maintain cultures of animal cells, establish cell lines with good viability, minimal contamination.

* Perform supportive tasks relevant to cell culture, including preparation and evaluation media.

* Recognize and troubleshoot problems, common to routine cell culture.

**List of Experiments**

1. Sterilization methods
2. Preparation of stock solutions
3. Preparation of medium
4. Establishment of callus cultures from carrot cambial explants
5. Establishment of cell culture
6. Establishment of growth and preparation of growth curve
7. Embryo culture of maize or any suitable crop, root/shoot initiation (organogenesis) from different explants
8. Micro propagation and plant regeneration
9. Isolation, culture and fusion of plant protoplasts
10. Anther and pollen culture

## BT-2107 : BIOANALYTICAL TECHNIQUES LABORATORY

**Course Objectives**

* Many scientific endeavors are dependent upon accurate quantification of drugs and endogenous substances in biological samples; the focus of bioanalysis in the pharmaceutical industry is to provide a quantitative measure of the active metabolite(s) for the purpose of pharmacokinetics, toxicokinetics, bioequivalence and exposure–response (pharmacokinetics/ pharmacodynamics studies). Modern drugs and bio molecules are more potent, which require more sensitive bioanalytical assays to accurately and reliably determine at lower concentrations.

**Course Outcomes:**

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

* Apply principles of various spectroscopic techniques.

* Identify compounds and their functional groups using HPLC.

* Select and apply various analytical techniques.

* Apply the technique of electrophoresis.

**List of Experiments:**

1. Determination of given sample using UV Visible Spectrophotometry.
2. Identification of given sample using Paper chromatography
3. Identification of given sample using Thin layer chromatography
4. Separation of proteins by SDS PAGE Electrophoresis technique.
5. Separation of bio molecules using Ion exchange chromatography
6. Instrumentation & Working of HPLC
7. Identification of bio molecules by HPLC
8. Estimation of pigments using Colorimetric methods.

## BT-2108 : DOWNSTREAM PROCESSING LABORATORY

**Course Objectives:**

The objective of this course is to enable students to

* Acquire knowledge of different techniques for solid-liquid separation, product release and purification of Biotechnology products.

* To design and execute efficient and sustainable downstream processes to achieve a pure bioproduct.

**Course Outcomes:**

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

* Understand the fundamentals of recovery/ purification operations for bio pharmaceutical production.

**List of Experiments**

1. Cell Disruption by Sonication
2. Cell Disruption by Enzymatic Reaction
3. Centrifugal Separation- Ultra Centrifugation, Gel Filtration
4. Micro filtration
5. Ultra filtration
6. Aqueous Two-phase Extraction
7. Dialysis

## BT-2109 : MATLAB

**Course Objectives:**

* The student will learn to apply the knowledge of *MATLAB* for solving Chemical Engineering problems.

**Course Outcomes:**

At the end of the course the student will be able to

* Apply Matlab to create and print arrays and execute function files
* Solve linear equations using Matlab
* Determine the curve fit equation for the given data
* Draw 2D plots and 3D plots for the given data

### SYLLABUS

**Introduction,** Tutorial lessons: *MATLAB* session, working with arrays of numbers, creating and printing simple data, saving and executing a script file, creating and executing function files, working with files and directories.

**Interactive computation -** Matrices and vectors, matrix and array operations, creating and using inline functions, using built in functions and online help, saving and loading data, plotting simple graphs.

**Script files**, function files, language specific features, advanced data objects.

**Applications -** linear algebra, curve fitting and interpolation, data analysis and statistics, numerical integration, ordinary differential equations, nonlinear algebraic equations.

**Basic 2D plots**, using subplot to layout multiple graphs. 3-D plots, symbolic Math tool box: two useful tools in symbolic Math tool box, using symbolic Math tool box.

Text Book**:**

'Getting started with *MATLAB*: A quick introduction for scientists and engineers' by Rudra Pratap, Oxford University press.

## BT-2110 : PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Common for all B.Tech and B.Tech+M.Tech Integrated Courses

(w.e.f. 2022-2023)

**Course Objectives:**

* To recognize the moral values that should guide the Engineering profession.
* To resolve moral issues concerning one's profession.
* To develop and exhibit a set of moral beliefs and attitudes that engineers should inculcate.
* To inculcate social values and morality in one's life.
* To develop awareness about Professional/Engineering Ethics and Human Values.

**Learning Outcomes:**

Students will be able to:

* Apply the conceptual understanding of ethics and values into everyday practice.
* Understand the importance of moral awareness and reasoning in life.
* Acquire professional and moral etiquette that an engineer requires.
* Develop the acumen for self-awareness and self-development.
* Develop cultural tolerance and integrity.
* Tackle real-life challenges with empathy.

### CONTENTS

Unit - I: HUMAN VALUES : Values - Respect - Caring - Sharing - Honesty- Courage - Self confidence - Communal Harmony Morals - Virtues

Unit –II PROFESSIONAL VALUES : Integrity - Discipline - Valuing time - Cooperation - Commitment - Code of conduct - Challenges in the workplace

Unit – III PROFESSIONAL ETHICS : Overview - Engineering ethics - Moral issues - Profession - Models of professional roles - Responsibility

Unit – IV RESPONSIBILITIES AND RIGHTS : Safety and risk - Collegiality and loyalty - Confidentiality - Occupational crime - Human rights - Employee rights - Intellectual property rights

Unit – V GLOBAL ISSUES : Globalization - Environmental ethics - Computer ethics - Code of ethics - Multinational corporations - Engineers as advisors in Planning and Policy making

Suggested Textbook:

R.S. Nagarazan. *A Textbook on Professional Ethics and Human Values.* New Age International Publishers. 2006.

Reference Books:

Premvir Kapoor. Professional Ethics and Human Values. Khanna Publishing House. 2019.

B.S. Raghavan. Human Values and Professional Ethics. S.Chand Publications. 2012.

R.R. Gaur & Others. A Foundation Course in Human Values and Proff. Ethics. Excel Books. 2009.

A. N. Tripathi. Human Values. New Age International (P) Limited. 2009

R. Subramanian. Professional Ethics. OUP India. 2013.

## BT-2111 : NCC/NSS

All the students should enroll either in NCC or NSS and get a satisfactory report.

## BT-2201 : GENETICS

**Course Objectives:**

* To introduce Mendel's law of inheritance.
* To introduce interaction of Genes and inheritance.
* To introduce Gene linkage, crossing over and mapping.
* To introduce sex determination & linkage.
* To introduce chromosomes & chromosomal variation.

**Course Outcomes:**

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

* Define inheritance and classify the types of inheritance.
* Different methods available to study genetics
* Performing of polymerized chain reaction, cloning and transformation
* Describe complementary, duplicate genes and interaction between different two gene pairs.
* Interpret sex determination mechanisms and inheritance of sex linked traits.
* Differentiate types of cytogenetic effects and numerical changes in chromosomes.

## SYLLABUS

**Mendel's law of Inheritance:** Mendel's experiments–Mendels materials, crossing technique, results of Mendel's experiments, phenomenon of dominance, variation in dominance relation, incomplete dominance, co-dominance, principle of segregation monohybrid cross, mechanism of segregation, monohybrid ratio, principle of independent assortment, Mendels dihybrid cross, mechanism of independent assortment, dihybrid ratio, back cross and test cross, deviations from dihybrid phenotypic ratio.

**Interaction of Genes:** Interaction of genes-combs in fowls, Epistasis, complementary genes, duplicate genes, additional interactions involving two gene pairs, interaction between more than two gene pairs.

**Quantitative/Multiple factor inheritance:** Multiple factors, quantitative and quantative traits, examples of quantitative inheritance, Kernel color in wheat, skin color in man, corolla length in tobacco, continuous variations.

**Multiple Alleles:** (Based on classical concept of Allelomorphism): Multiple alleles and isoalleles, skin color in rodents, eye color in Drosophila, self sterility in Nicotiana, blood groups in humans, complementation test or cis-trans test.

**Linkage, crossing over and mapping:** Linkage – coupling and repulsion hypothesis, Morgan's view on linkage, chromosome theory of linkage, kinds of linkage-complete linkage, incomplete linkage,linkage groups, significance of linkage.

**Crossing over** – Types of crossing over - mitotic and meiotic crossing over,mechanism - synapsis, duplication of chromosomes, crossing over by breakage and union, terminalization, Molecular mechanism of recombination- Holiday model, cytological basis of crossingover; significance of crossing over.

**Construction of a genetic mapping:** Two point and three point test crosses and gene mapping, interference and coincidence.

**Sex Determination:** Genetically controlled sex determining mechanisms, sex chromosomal mechanism of sex determination, types-heterogenetic males, heterogenetic females, genic balance mechanism (X/A ratio in Drosophila), sex determination in man (TDF and SRY genes), sex determination in plants; Single gene control of sex; haploid males in hymenoptera; hormonal control of sex, environmental control of sex, dosage compensation (in man and Drosophila).

**Sex Linkage:** Inheritance of sex linked (X-linked) traits-eye color in Drosophila, haemophilia and color blindness in human and barred plumage in poultry, inheritance of Y-linked genes, inheritance of XY-linked genes, primary and secondary non-disjunction of sex chromosomes, sex influenced and sex limited traits, sex linked disorders in human beings.

**CytoplasamicInheritance:** Maternal effects-shell coiling in snails, pigment in flour moth, cytoplasmic inheritance involving dispensable heredity units, kappa particles in Paramecium, cytoplasmic inheritance by cellular organelles, plastid inheritance in variegated four-o-clock plant, mitochondrial inheritance, male sterility in plants, uniparental inheritance in chlymadomonas.

**Chromosomal variations:** Origin, types and cytogenetic effects,

**Structural changes in chromosomes:** Duplications, translocations, inversions (paracentric and pericentric cross over suppressors).

**Numerical changes in chromosomes:** Aneuploidy (monosomy, nullisomy, trisomy, tetrasomy), euploidy (monoploidy, haploidy, polyploidy-autopolyploids and allopolyploids).

Text Books:

1. "Genetics", by P.K.Gupta, Rastogi Publications

2. "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology", by P.S. Verma & V.K. Agarwal, S. Chand & Company

Reference Books:

1. "Principles of Genetics", by E.J. Gardner, M.J.Simmons & D.Peter Snustard, John Wiley & Sons, INC. Publishing Co.

2. 'Essentials of Materials Science' by A.G. Guy.

3. An introduction to corrosion science and engineering By Herbert Uhilig and R. Winston Revie, Published by John Wiley and sons, New York

## BT-2202 : MATERIAL & ENERGY BALANCES

**Course Objectives:**

* To give intensive quantitative training in the practical applications of the principles of physical chemistry to the solution of complicated industrial problems and in methods of predicting missing physicochemical data from generalized principles.

**Course Outcomes**:

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

* Convert physico-chemical quantities from one system of units to another

* Identify basis and degrees of freedom

* Perform material and energy balances on single units without and with chemical reactions

* Solve the material and energy balance problems on multi-unit processes with recycle, purge and bypass

* Analyze the ideal and real behavior of gases, vapors and liquids

## SYLLABUS

**Stoichiometry and composition relationships**- the gram-mole and pound-mole, limiting reactant, excess reactant, degree of completion, basis of calculation, weight percent, volume percent and mole percent, density and specific gravity- Baume and API gravity scales, Behavior of ideal gases- application of the ideal-gas law, Dalton and Amagat laws to gaseous mixtures, composition of gases on dry basis and on wet basis, Vapor pressures- Effect of temperature on vapor pressure, Antoine equation, reference substance vapor pressure plots, vapor pressure of immiscible liquids, ideal solutions and Raoult's law, non-volatile solutes,

**Humidity -** Percentage saturation, relative saturation or relative humidity, dew point, vaporization, condensation, wet and dry bulb temperatures, adiabatic vaporization and adiabatic saturation temperature,

**Material balances-** Tie substance, yield, conversion, processes involving chemical reactions, material balance- calculations involving drying, dissolution, and crystallization, processes involving recycle, bypass and purge,

**Heat capacities of gases and gaseous mixtures-** effect of temperature on heat capacity of gas, mean heat capacity of gas, Kopp's rule, latent heats, heat of fusion, heat of vaporization, Trouton's rule, Kistyakowsky equation for non-polar liquids, estimation of latent heat of vaporization using Classius-Clayperon equation, enthalpy of humid air and humid heat capacity,

**Standard heat of reaction** - Standard heat of formation, laws of thermochemistry, standard heat of combustion, calculation of heat of formation from heats of combustion, calculation standard heat of reaction from heats of formation and from heats of combustion, standard integral heat of solution, effect of temperature on heat of reaction, Kirchoff's equation, adiabatic and non- adiabatic reactions, theoretical and actual flame temperatures.

Text Book:

'Chemical Process Principles, Part-I - Material and Energy balances' by Olaf A Hougen, K.M. Watson and R.A.Ragatz, CBS Publishers and Distributors (1995)

Reference Books:

1. 'Basic principles and Calculations in Chemical Engineering' by David M. Himmelblau, Prentice Hall of India Pvt Ltd, 1995

2. 'Stoichiometry' by B.I. Bhatt and S.M. Vora, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi (1996)

3. 'Stoichiometry for Chemical Engineers' by Williams and Johnson, McGraw Hill Publishers.

## BT-2203 : FLUID MECHANICS AND PARTICLE TECHNOLOGY

**Course objectives**

To provide

* Knowledge on pressure distribution in static fluids.

* Knowledge on rheological behavior of fluids, types of fluid flow, boundary layers and basic equations of fluid flow.

* Knowledge of incompressible fluid flow in pipes

* Knowledge on pipes, fittings, transportation and metering devices.

* To make the students exposed to different geometrical sizes of particles of raw materials used in the industries, area of calculation of the particles w.r.t their sizes

* To get familiarity with the different laws of grinding

* To know the movement of particles in different liquids (viscous) and filtration techniques

**Course Outcomes:**

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

* Estimate the pressure drop.

* Calculate the pumping capacity and friction losses of flowing fluids.

* Differentiate pumps based on their performance.

* Select proper measuring device and estimate the quantity of flow.

* Syllabus Select suitable size reduction equipment based on performance and power requirement.

* Analyze particle size distribution of solids

* Evaluate solid-fluid separation equipment

## SYLLABUS

Fluid Mechanics : **Fluid statics and applications**: Units and Dimensions, Dimensional Homogeneity, Nature of fluids, Hydrostatic Equilibrium, Applications of fluid statics – Manometers, continuous gravity decanter and centrifugal decanter.

**Fluid Flow phenomena:** Laminar flow, shear rate, shear stress. Rheological properties of fluids – Newtonian fluids, Non Newtonian fluids, time dependent flow, viscoelastic fluids. Viscosity, Reynolds number, Turbulence - nature of turbulence. Boundary layers - boundary layer formation over flat plate, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary layer formation in straight tubes, boundary layer separation and wake formation.

**Basic Equations of Fluid Flow:** Continuity equation (Mass Balance in a flowing fluid), equation of motion (Differential Momentum Balance), Navier - stokes equations, Euler's equation, Couette flow, Macroscopic Momentum Balance, layer flow with free surface, Bernoulli equation (Energy equation), corrections for effect of solid boundaries and pump work.

**Incompressible flow in pipes and channels** : Shear Stress and skin friction in pipes, Relation with skin friction and wall shear, Friction factor, relations between skin friction parameters, equivalent diameter, laminar flow in pipes and channels, velocity distribution, average velocity, Kinetic energy correction factor and momentum correction factor for laminar flow, Hagen-Poiseuille equation, laminar flow of non-Newtonian liquids, laminar flow in annulus. Friction from changes in velocity or direction – sudden expansion, sudden contraction, pipe fittings, friction losses in Bernoulli equation, velocity heads, separation of boundary layer in diverging channel, minimizing losses.

Transportation of Fluids: Pipes, fittings, valves, positive displacement pumps (reciprocating, rotary and peristaltic pumps), centrifugal pumps

**Metering of fluids:** Full bore meters – Venturi meter, Orifice meter and Rotameters.

**Particle Technology**: Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numerical of differential and cumulative analysis.

**Size reduction –** characteristics of comminuted products, crushing laws, working principle of ball mill., Mixing – types of mixers (ribbon and muller mixer), power number and power number calculation; Filtration & types, filtration equipments (plate and frame, rotary drum) conceptual numerical

**Flow past immersed bodies –** drag and drag co-efficients, application of Kozney Karmen & Burke Plummer equation; Flow through stagnant fluids – theory of Settling and Sedimentation – Equipments (cyclones, thickners) conceptual numerical, Particle size enlargement

Text Book:

"Unit Operations of Chemical Engineering" Seventh Edition, by W.L. McCabe, J C Smith and P Harriot, Mc Graw Hill

Reference Book:

"Introduction to Chemical Engineering" by W L Badger and J T Banchero, Tata Mc Graw Hill

## BT-2204 : BIOCHEMICAL THERMODYNAMICS

**Course Objectives:**

* To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and to predict phase equilibria and chemical reaction equilibrium.

**Course Outcomes:**

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

* Understand the laws of thermodynamics

* Understand the degrees of freedom and phase & chemical reaction equilibria

* Calculate thermodynamic parameters involved in biochemical reactions

* Differentiate between ideal and non-ideal solutions

## SYLLABUS

**The first law and other basic concepts:** Internal energy, the first law of thermodynamics, thermodynamics state and state functions, enthalpy, the Steady state Steady flow process, the reversible process, constant V and constant P processes.

Heat effects: Latent heats of pure substances, standard heat of reaction, standard heat of formation, standard heat of combustion.Temperature dependence of heat effects of chemical reactions.

**The second law of Thermodynamics:** Statement of the second law, heat engines, entropy changes of an ideal gas, mathematical statement of second law, the third law of thermodynamics.

**Thermodynamic properties of fluids :** Property relations for homogeneous phases, residual properties, Solution thermodynamics : partial properties, concepts of chemical potential and fugacity, ideal and non-ideal solutions, Gibbs-Duhem equation, excess properties of mixture, activity coefficients and correlations.

Criteria for phase equilibria: Vapour-liquid equilibrium calculations for binary mixtures, Liquid-liquid equilibria and solid liquid equilibria, Chemical reaction equilibria.

**Biochemical thermodynamics:** Energetics of metabolic pathways, Energy coupling (ATP & NADH), Energetic analysis of cell growth and product formation. Thermodynamics of microbial growth, oxygen consumption and heat evolution in aerobic cultures, energy balance equation for cell culture.

Text Books:

1. Introduction to Chemical Engineering Thermodynamics by J.M. Smith, H.C. Van Ness and M.M. Abbott, 6th Ed. McGraw-Hill, 2000.
2. Kinetics and Energetics in Biotechnology, J.A. Roels, Elsevier, 1983.

Reference Book:

1. Chemical Engineering Thermodynamics, Y.V.C. Rao, University Press.

## BT-2205 : PYTHON PROGRAMMING

**Course Objectives**

1. To develop skills on procedural oriented and object oriented programming in Python
2. To understand and apply different data wrangling techniques using Python.
3. To perform data analysis using python libraries like NumPy, Pandas and exploratory data analysis using Matplotlib

**Course Outcomes**

At the end of the course, a student should be able to:

1. acquire programming knowledge on Basics of Python
2. acquire programming knowledge on Text and File Handling
3. develop Python programs to Mean, Median, Mode, Correlation
4. acquire programming knowledge on NumPy, Pandas Library
5. acquire programming knowledge on Graph Visualizations in Python and Data Analysis using Python

## SYLLABUS

1. Introduction to Python: Rapid Introduction to Procedular Programming, Data Types: Identifiers and Keywords, Integral Types, Floating Point Types

Strings: Strings, Comparing Strings, Slicing and Striding Strings, String Operators and Methods, String formatting with str.format

Collections Data Types: Tuples, Lists, Sets, dictionaries, Iterating and copying collections

2. Python Control Structures, Functions and OOP: Control Structures and Functions: Conditional Branching, Looping, Exception Handling, Custom Fuctions

Python Library Modules: random, math, time, os, shutil, sys, glob, re, statistics, creating a custom module

Object Oriented Programming: Object Oriented Concepts and Terminology, Custom Classes, Attributes and Methods, Inheritance and Polymorphism, Using Properties to Control Attribute Access

File Handling: Writing and Reading Binary Data, Writing and Parsing Text Files

3. NumPy Arrays and Vectorized Computation: NumPy arrays, Array creation, Indexing and slicing, Fancy indexing, Numerical operations on arrays, Array functions, Data processing using arrays, Loading and saving data, Saving an array, Loading an array, Linear algebra with NumPy, NumPy random numbers

4. Data Analysis with Pandas: An overview of the Pandas package, The Pandas data structure-Series, The DataFrame, The Essential Basic Functionality: Reindexing and altering labels , Head and tail, Binary operations, Functional statistics , Function application Sorting, Indexing and selecting data, Computational tools, Working with Missing Data, Advanced Uses of Pandas for Data Analysis - Hierarchical indexing, The Panel data

5. Data Analysis Application Examples: Data munging, Cleaning data, Filtering, Merging data, Reshaping data, Data aggregation, Grouping data

6. Data Visualization: The matplotlib API primer-Line properties, Figures and subplots, Exploring plot types-Scatter plots, Bar plots, Histogram plots, Legends and annotations, Plotting functions with Pandas

Text Books

1. Programming in Python 3: A Complete Introduction to Python Language, Mark Summerfield, Second Edition, Addison-Wesley Publications
2. Python: End-to-End Data Analysis Learning Path, Module 1: Getting Started with Python Data Analysis , Phuong VothiHong , Martin Czygan, , Packt Publishing Ltd

Reference Books

1. Learning Python, 5th Edition, Mark Lutz, Orielly Publications

2. Python for Data Analysis, Wes McKinney, Orielly Publications

3. How to Think Like a Computer Scientist: Learning with Python 3 Documentation 3rd Edition, Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers

4. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall

5. Python Cookbook – Recipes for Mastering Python 3,3rdEdition, David Beazley, Brian K. Jones, Oreilly

## BT-2206 : FLUID MECHANICS AND PARTICLE TECHNOLOGY LABORATORY

**Course Objectives:**

* The student will be exposed to various fluid measuring devices and pumps. The pressure drop calculation experimentally across the pipe and packed bed will also be dealt in this lab.

* The student is introduced to the concepts of sampling, processing of solid raw materials. The student also gets hands on training on operating various machines used for processing of solids.

**Course Outcomes:**

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

* Distinguish laminar and turbulent flows.

* Determine the characteristics of flow meters

* Determine the characteristics of packed beds and centrifugal pumps

* Calculate pressure drop across a pipe

* Select suitable methods for size reduction of minerals or other intermediates

* Analyze particle size distribution of solids

* Evaluate suitable mechanical separations of solid-liquid.

**List of Experiments**

1. Variation of orifice coefficient with Reynolds number Friction loses for flow through pipe.
2. Calibration of Rotameter
3. Verification of Bernoullis Theorem
4. Pressure drop in a packed bed for different fluid velocities
5. To study the characteristics of a centrifugal pump
6. Batch sedimentation
7. Ball Mill
8. Cyclone separator /Trommel
9. Leaf / Pressure filter/Sampling techniques
10. Screen analysis/effectivenes

## BT-2207 : PYTHON PROGRAMMING LABORATORY

**Course Objectives**

1. familiarize students with key data structures in Python including lists and dictionaries and apply them in context of searching, sorting, text and file handling

2. introduce students to calculation of statistical measures using Python such as measures of central tendency, correlation

3. familiarize students with important Python data related libraries such as Numpy and Pandas and use them to manipulate arrays and dataframes

4. introduce students to data visualization in Python through creation of line plots, histograms, scatter plots, box plots and others

5. implementation of basic machine learning tasks in Python including pre-processing data, dimensionality reduction of data using PCA, clustering, classification and cross-validation.

**Course Outcomes**

After completion of the course the student should be able to:

1. implement searching, sorting and handle text and files using Python data structures such as lists and dictionaries

2. calculate statistical measures using Python such as measures of central tendency, correlation

3. use Python data related libraries such as Numpy and Pandas and create data visualizations

4. implement basic machine learning tasks pre-processing data, compressing data, clustering, classification and cross-validation.

### SYLLABUS

1. Python Programs on lists & Dictionaries
2. Python Programs on Searching and sorting
3. Python Programs on Text Handling
4. Python Programs on File Handling
5. Python Programs for calculating Mean, Mode, Median, Variance, Standard Deviation

6. Python Programs for Karl Pearson Coefficient of Correlation, Rank Correlation

7. Python Programs on NumPy Arrays, Linear algebra with NumPy

8. Python Programs for creation and manipulation of DataFrames using Pandas Library

**9.** Write a Python program for the following**.**

* Simple Line Plots,

* Adjusting the Plot: Line Colors and Styles, Axes Limits, Labeling Plots,

* Simple Scatter Plots,

* Histograms,

* Customizing Plot Legends,

* Choosing Elements for the Legend,

* Boxplot

* Multiple Legends,

* Customizing Colorbars,

* Multiple Subplots,

* Text and Annotation,

* Customizing Ticks

10. Python Programs for Data preprocessing: Handling missing values, handling categorical data, bringing features to same scale, selecting meaningful features

11. Python Program for Compressing data via dimensionality reduction: PCA

12. Python Programs for Data Clustering

13. Python Programs for Classification

14. Python Programs for Model Evaluation: K-fold cross validation

Reference Books

1. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall

2. Chris Albon, “Machine Learning with Python Cookbook-practical solutions from preprocessing to Deep learning”, O’REILLY Publisher,2018

3. Mark Summerfield, Programming in Python 3—A Complete Introduction to the Python Language, Second Edition, Additson Wesley

4. Phuong Vo.T.H , Martin Czygan, Getting Started with Python Data Analysis, Packt Publishing Ltd

5. Armando Fandango, Python Data Analysis, Packt Publishing Ltd

6. Magnus Vilhelm Persson and Luiz Felipe Martins, Mastering Python Data Analysis, Packt Publishing Ltd

7. Sebastian Raschka& Vahid Mirjalili, “Python Machine Learning”, Packt Publisher, 2017

## BT-2208 : BIOSTATISTICS

**Course Objectives:**

* To make them understand about the Introduction of bioinformatics, Moments like skewness and kurtosis, correlation, Probability distribution and sampling theory, Sampling Theory: sampling, random sampling, parameters and statistic, objectives of sampling and Numerical solutions of PDEs.

**Course Outcomes:**

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

* Classify data and understand relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion.

* Understand coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation.

* Solve PDE’s numerically

* Explain probability distribution and sampling theory

## SYLLABUS

**Introduction**, collection and classification of data, graphical representation, histogram, frequency polygon and cumulative frequency curve, comparison of frequency distributions, measures of central tendency, mean, median and mode, an empirical relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion – range, quartile deviation or semi-inter quartile range, mean deviation, root mean square deviation, standard deviation, variance, coefficient of variation, empirical relation between measures of dispersion, standard deviation of combined samples.

**Moments**, skewness and kurtosis, correlation, scatter diagram, coefficient of correlationboth for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation.

**Probability distribution and sampling theory:** Random variable both discrete andcontinuous, probability distribution both discrete and continuous, cumulative distribution, expectation, variance, standard deviation, moment generating function, binomial distribution, constants of binomial distribution, mean, standard deviation, skewness and kurtosis, fitness of a binomial distribution, Poisson distribution, constant of poisson distribution, mean, standard deviation, skewness and kurtosis – fitting of a poisson distribution, normal distribution, standard normal distribution, propertive normal distribution, probability error, fitting of normal distribution.

**Sampling Theory:** sampling, random sampling, parameters and statistic, objectives of sampling, sampling distribution, standard error, testing of hypothesis, errors, null hypothesis, level of significance, testing significance, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples, test of significance for means of two large samples, sampling of variables, small samples, number of degrees of student t-distribution, significance test of difference between sample means, f- distribution, Fisher's z-distribution, Chi-square distribution.

**Numerical solutions of PDEs** – Elliptic (Liebmann iteration process), Parabolic (Schmidt explicit formula), Hyperbolic and Poisson's equations (Gauss – siedel method).

Text Book:

Higher engineering mathematics by B.S.Grewal

References Books:

1. Numerical methods for Scientific and Engineering Computation by M.K.Jain, S.R.K.Iyengar, R.K.Jain, and Publishers New age international (P) Ltd. New Delhi

2. Probability, Statistics and random process by T. Veerarajan, Tata McGraw Hill.

3. Probability, Statistics with Reliability, Queing and Computer Science Application by Kishore S. Trivedi

## BT-2209 : ENVIRONMENTAL SCIENCE

**Course Objectives:**

* The aim of this course is to make the students better understand the changes in the environment and be given a greater voice and planning conservation through an interdisciplinary environmental science curriculum that is design to enhance scientific enquiry and to strengthen competence.

**Course Outcomes**:

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

* Understand various types of pollution regulations and their scientific bases.

* Apply knowledge for the protection and improvement of the environment.

* Recognize the major concepts in environmental science and demonstrating in-depth of the environment

## SYLLABUS

**Introduction:** Definition, scope and importance, measuring and defining environmental development – indicators

**Ecosystems:** Introduction, types, characteristic features, structure and functions of ecosystems –forest, grassland, desert, aquatic (lakes, rivers and estuaries)

**Environmental and natural resources management:** Land resources-land as a resource, common property resources, land degradation, soil erosion and desertification, effects of modern agriculture, fertilizer-pesticide problems

**Forest resources-** use and over-exploitation, mining and dams –their effects on forest and tribal people

**Water resources –** use and over utilization of surface and ground water, floods, droughts, water logging and salinity, dams-benefits and costs, conflicts over water

**Energy resources-** Energy needs, renewable and non-renewable energy sources, use of alternate energy sources, impact of energy use on environment

**Bio-diversity and its conservation:** Value of bio-diversity- consumptive and productive use, social, ethical, aesthetic and option values, bio-geographical classification of India - India as a mega diversity nation, threats to biodiversity, hot spots, habitat loss, poaching of wild life, loss of species, seeds etc., conservation of biodiversity - in-situ and ex-situ conservation

**Environmental pollution- local and global issues**: Causes, effects and control measures of air pollution, indoor air pollution, water pollution, soil pollution, marine pollution, noise pollution, solid waste management, composting, vermiculture, urban and industrial wastes, recycling and re-use, nature of thermal pollution and nuclear hazards, global warming, acid rain , ozone depletion

**Environmental problems in India**: Drinking water, sanitation and public health, effects of activities on the quality of environment, urbanization, transportation, industrialization, green revolution, water scarcity and ground water depletion, controversies on major dams – resettlement and rehabilitation of people: problems and concerns, rain water harvesting, cloud seeding and watershed management

**Economy and environment**: The economy and environment interaction, economics of development, preservation and conservation, sustainability: theory and practice, limits to growth, equitable use of resources for sustainable lifestyles, environmental impact assessment

**Social issues and the environment**: Population growth and environment, environmental education, environment movements, environment versus development

**Institutions and governance**: Regulation by Government, monitoring and enforcement of environmental regulation, environmental Acts, water (prevention and control of pollution) act, air (prevention and control of pollution) act,

environment .protection act, wild life protection act, forest conservation act, coastal zone regulations, institutions and policies relating to India, environ- mental governance

**International conventions**: Stockholm conference-1972, Earth summit- 1992, World commission for environmental development (WCED)

**Case studies**: Chipko movement, Narmada bachaoandolan, Silent val- ley project, Madhura refinery and Taj mahal, Industrialization of Pattancheru, Nuclear reactor at Nagarjuna sagar, Tehri dam, Ralegaon siddhi (Anna Hazare),Kolleru lake-aquaculture, Fluorosis in Andhra Pradesh

**Field work**: Visit to a local area to document and mapping environmentalassets – river/forest/grass land / hill/ mountain, study of local environment- common plants, insects, birds, study of simple ecosystems – pond, river hill, slopes etc, visits to industries- water treatment plants, effluent treatment plants

Text Book:

Environmental Studies by Anubha Kaushik & C.P. Kaushik, Second Edi-tion, New Age International (P) Limited.