

NOTIFICATION

No. 90 /2020

Date : 26/10/2020

**Subject : Implementation of new Syllabi of Semester III & IV B.E. (Chemical) / B. Text. E./ B.Tech. (Chem.) (Tech.) (Food, Pulp & Paper, Oil & Paint and Petrochemical Tech.) (C.B.C.S.) as per A.I.C.T.E. Model Curriculum ...**

It is notified for general information of all concerned that the authorities of the University have accepted to implement new Syllabi of Semester III & IV of of B.E.(Chemical)/B.Text.E./B.Tech. (Chem.) (Tech.) (Food, Pulp & Paper, Oil & Paint and Petrochemical Tech.) (C.B.C.S.) as per A.I.C.T.E. Model Curriculum to be implemented from the academic session 2020-21 & onwards as per “Appendix-A” as given :

Sd/-  
(Dr.T.R.Deshmukh)  
Registrar

“Appendix – A”

SYLLABUS OF B.TEXT. ENGG. SEM. III & IV C.B.C.S.]

**3 TX 01 Textile Fibre -I**

**Course objectives :**

- 1) To gain basic knowledge about essential and desirable properties of textile fibres and their classification.
- 2) To gain the knowledge about various textile natural fibres.
- 3) To understand various methods for analyzing fibre structure.

**Course outcomes :**

After the completion of Textile Fibre –I course, students will able to demonstrate,

- 1) the essential and desirable properties of Textile fibre and their classification
- 2) the physical, chemical and biological properties of cotton fibre
- 3) the physical, chemical and biological properties of jute and flax
- 4) the physical, chemical and biological properties of wool
- 5) the physical, chemical and biological properties of Silk
- 6) the various methods for analyzing fibre structure

**SECTION-A**

**Unit-I:** Definition of fibre, Classification of Textile fibres, Essential and desirable properties of Textile fibres, Polymers: Definition, Types of polymers, Requirements of fibre forming polymers. Basic structure of fibre: Concept of molecular weight, Degree of polymerization, Orientation and crystallinity, effect of orientation and crystallinity on the properties of fibres.

**Unit-II:** Cotton: Introduction, structure of Cotton fibre, fibre morphology, cotton polymer system, Physical, chemical and biological properties, Applications. Introduction to Banana, Pineapple fibres and their distinctive features and applications.

**Unit-III:** Jute: Cultivation and Extraction of Jute fibre, Structure of jute fibre, physical, chemical and biological properties, Applications. Flax: Retting and extraction process, structure of flax fibre, physical, chemical and biological properties, Applications. Introduction to hemp, ramie fibres and their distinctive features and applications.

**SECTION-B**

**Unit-IV:** Wool: Types of wool, grading of wool, Structure of wool, chemical composition, polymer system of wool, Physical, chemical and biological properties, Applications. Introduction to fibres like, mohair, camel, alpaca and their distinctive features and applications.

**Unit-V:** Silk: Types of silk, Production of silk (life cycle, reeling), Structure of silk, chemical composition, polymer system of silk, Physical, chemical and biological properties, Applications, blending opportunities in silk.

**Unit-VI:** Analysis of fibre structure: Introduction, crystal structure, and polymer crystals. i) X-ray diffraction: Bragg's law, X-ray diffractometer. ii) Electron microscopy: Principle and working of Transmission and scanning electron microscope. iii) Spectroscopy: Principle and working of IR-Spectroscopy and NMR-Spectroscopy. Introduction to thermal analysis of polymers.

All above experiments are to be arranged in the laboratory. Minimum 8 experiments are required to be performed by the student to complete the term work.

**4CH10 CHEMICAL ENGINEERING OPERATIONS-I LAB (MECH. OPERATIONS) -LAB**

- To study the performance of Ball Mill and find out it's crushing efficiency.
- To study the performance of Jaw Crusher and find out it's crushing efficiency.
- To study the performance of Crushing Rolls and find out it's crushing efficiency.
- To study the settling characteristics (Free & Hindered settling) of a given suspension of particles.
- To study the filtration characteristics of rotary vacuum filter.
- To study the filtration characteristics of Plate and frame filter press.
- To study the filtration characteristics of Leaf and sparkle filter.
- To carry out differential and cumulative screen analysis of given sample of solid particles.
- To determine energy consumption and crushing law constants for jaw crusher.
- To determine Critical speed of Ball mill & Average particle size of the product obtained in ball mill, **OR** Average particle size of product obtained in Bhrustone mill.
- To determine area of batch thickener by conducting batch sedimentation test.
- To determine efficiency of Cyclone separator.
- To Determine Variation of size reduction in ball Mill by changing the residence time, size of grinding medium and material of grinding medium.

All above experiments are to be arranged in the laboratory. Minimum 8 experiments are required to be performed by the student to complete the term work.

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**SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE**

**BACHELOR OF TECHNOLOGY CHEMICAL TECHNOLOGY**

**SEMESTER PATTERN (CHOICE BASED CREDIT GRADE SYSTEM)**

**SEMESTER : THIRD**

**3CT01 APPLIED ORGANIC CHEMISTRY**

**Course Objectives:**

1. Students will get introduced to aromatic compounds, heterocyclic chemistry and natural products, properties and applications of phenols, ethers, epoxides, amines and their derivatives.
2. Student will get the knowledge about the chemistry of unit process, kinetics and mechanism of Nitration, sulphonation and sulphation.
3. Students will get introduces to polymer chemistry and technical preparation of some polymers.

**Course Outcomes:**

Students will be able to -

1. Analyzed aromaticity and list properties of aromatic compounds.
2. Write simple mechanisms of aromatic reactions.
3. List some of the heterocyclic chemistry and chemistry of natural products.
4. List some properties of amines and their derivatives.
5. Know the unit process like halogenation, sulfonation and nitration.
6. Synthesized some simple organic compounds, polymers and understand the kinetics and mechanism of unit processes.

SECTION-A

**Unit I :** 1. Aromatic hydrocarbons : Preparation, properties and applications of Benzene, and Naphthalene  
2. Heterocyclic compounds: Classification of heterocyclic compounds, preparation, Properties and applications of pyrrole, thiophene, & furan (8 Hrs.)

**Unit II :** 1. Phenols : Basic concepts, classification, preparation, properties and applications of Phenol, resorcinols, cresols, catechol.

2. Ethers, epoxides and sulphur acids: Methods of preparation, General reaction, ethylene and propyleneoxides – their reactions and applications (8 Hrs.)

**Unit III : Amines and their derivatives :** Basic concepts, classification of amines, preparation, properties and applications of aniline and Benzene diazonium chloride.

**Natural products:** Terpenes, alkaloids, plant pigments, their applications (8 Hrs.)

SECTION-B

**Unit IV :** 1) Study of Chemistry of Unit Process : Nitration, nitrating agents, kinetics and mechanism of aromatic nitration. Technical preparation of nitrobenzene and nitronaphthalene.

2) Study of Chemistry of Unit Process : Sulphonation and Sulphation : Sulphonating & Sulphating agents, kinetics of mechanism of sulphonation. Technical preparation of Sulphonation of Benzene (8 Hrs.)

**Unit V :** 1) Study of Chemistry of Unit Process : Halogenation : Halogenating agents, thermodynamics, kinetics  
Technical preparation of DDT and Vinyl chlorides.

2) Principles of polymer chemistry and practices: Classification of polymerization. Types of polymers. Technical preparation of Polyvinylchloride, Bakelite. (10 Hrs.)

**Unit VI:** 1) Carbohydrates: Basic concepts, classification, industrial applications of glucose, sucrose and starch.

2) Chemicals in food products: Study of preservatives, sweetening agents and antioxidants. (6 Hrs.)

**Books Recommended :**

- 1) Organic Chemistry (Vol. I & II): I.L.Finar, Longman Group Ltd. And the English Language Book Society, London, 6<sup>th</sup> edition.
- 2) Advance Organic Chemistry: Fieser and Fieser, Asia Pub. House, Mumbai, 1961.
- 3) Unit Process in Organic Synthesis: P.H.Groggins, McGraw Hill, 5<sup>th</sup> edition.

3CT02 APPLIED PHYSICAL CHEMISTRY

Teaching Scheme:

(Th)Lecture: 03 Hours / week

Tutorial: 01 Hour /week

Total credit: 04

Examination Scheme:

T (U) : 80 Marks T (I) : 20 Marks

Duration of Univ. Exam : 03 Hours

**Learning Objectives:**

- To understand the effect of structure on properties of polymer, concept of weight average and number average molecular weight of macromolecules.
- To understand the electrical properties of fluid.
- To know the rate, order, energy of activation of chemical reactions and their determination.
- To know the use of kinetics and thermodynamics to elucidate mechanisms of reactions.
- To understand the basic concepts, the 1<sup>st</sup> and 2<sup>nd</sup> Laws of Thermodynamics, Thermodynamic functions and their applications.
- To predict the high and low quantum yield photochemical reactions and to know about advanced spectroscopic analysis techniques.
- To know the basic concepts and industrial examples of catalysis and adsorption on surface.

**Course outcomes :**

The course will enable the student to:

- Evaluate the structural properties of macromolecules, average molecular weight determination of polymers by various methods.
- Evaluate the specific rate, order and energy of activation of chemical reactions.
- Know the fundamental concepts related to homogeneous and heterogeneous catalysis, mechanisms of industrially important reactions, surface phenomenon and adsorption isotherms.
- Apply mass and energy balances to closed and open systems, Rationalize bulk properties and processes using thermodynamic considerations
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques and spectroscopic methods for identification of compounds.
- Know the ion transport & electrical properties of solutions, solve problems involving transport no, electrode potential and emf of different types of cell.

**Contents:**

**Unit- I : Ion transport and electrical phenomenon at interface:** Specific, Equivalent and Molar conductivity, Kohlraush's law and its applications, Transport number and their determination, Reversible and reference electrode, Thermodynamics of reversible electrode, Relation between electrical work done and free energy, Nernst equation for electrode potential, Standard electrode potential, Electrolytic concentration cell with and without transference, Determination of pH, solubility and solubility product of sparingly soluble salts, dissociation constant by EMF measurement, Numerical. (8 Hrs.)

**Unit-II : Polymer science:** Number average and weight average molecular weight of macromolecule, Methods of molecular weight determination of macromolecules, Membrane osmometry, Light scattering, sedimentation and ultracentrifuge methods, Effect of polymer structure on properties of polymers. Numerical on molecular weight determination. (6 Hrs)

**Unit- III : Kinetics & Reaction mechanism:** Introduction, Rate of reaction, concept of molecularity and order in elementary and complex reactions, differential and integral methods to formulate rate equations of zero, first and second order reactions. experimental methods in kinetic studies, effect of temperature on reaction rate, energy of activation and its determination, steady state approximation and rate determining step, Mechanism of complex reactions, photochemical chain reactions, polymerization reactions. Fast reactions – experimental techniques. Numerical (10 Hrs.)

**Unit-IV : Surface, interfacial chemistry and catalysis:** Adsorption, types of adsorption, Adsorption isotherms, Langmuir theory of adsorption, BET adsorption isotherm and its application for determination of surface area of fine powder. Homogeneous and Heterogeneous catalysis, Criteria of catalyst, Theory of heterogeneous catalysis, Homogeneous, Lewis acid-base catalysts, organometallic catalysts and industrially examples, Auto and enzyme catalysis. kinetics of reactions on surfaces. (8 Hrs.)

**Unit – V : Thermodynamics and Equilibrium :** Statements of the second law; Heat engines, Carnot's theorem, and Carnot cycle, Mathematical statement of the second law, Introduction of Entropy under the II<sup>nd</sup> Law to define spontaneity of a process, Temperature- entropy diagram, Introduction of the state functions A & G to determine conditions of Material Equilibrium. Condition of reversibility, Transformation at constant temperature and pressure, Gibbs- Helmholtz equation, pressure – volume and volume – Temperature relationship under isothermal condition for ideal gas. Partialmolar properties, chemical potential, Numerical. (8 Hrs.)

**Unit VI: Spectroscopic techniques and applications :** Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational and rotational spectroscopy of diatomic molecules. Principle, Instrumentation and Applications of IR, UV & NMR spectroscopy

**Photochemistry and Modern Analytical techniques:** Laws of photochemistry, quantum efficiency and its determination, low & high quantum yield reactions, Atomic absorption spectroscopy, chromatography. (8 Hrs.)

**Books Recommended :**

1. Physical Chemistry, P.W. Atkins and J.D. Paula, Oxford University Press.
2. Physical Chemistry, K.J. Laidler and J.M. Meiser, CBS Publisher
3. Chemical kinetics and catalysis, R. J. Masel, John Wiley publications
4. Handbook of conducting polymers, Skotheim, Elsenbaumer and Reynolds, Marce Dekker.
5. Fundamentals of spectroscopy, Banwell, Tata McGraw-Hill
6. Physical chemistry of surfaces, Arthur W. Adamsons, Alice P. Gast, John Wiley publications
7. Principle of Heterogeneous catalysis, J.M.Thomas, W.J. Thomas, John Wiley publications
8. Thermodynamics for students of chemistry, Dr. J. Rajaram & Dr. J. C. Kuriacose, Chand & comp.

3 CH 03 /3CT03 STRENGTH OF MATERIALS

**Learning Objectives of Subject:**

1. To determine the Mechanical behavior of the body and construction materials by determining the stresses, strains produced by the application of loads.
2. To apply the fundamentals of simple stresses and strains.
3. To make one understand the concept of bending and its theoretical analysis.
4. To apply fundamental concepts related to deformation, moment of inertia, load carrying capacity, shear forces, bending moments, torsional moments, principal stresses and strains, slopes and deflection.

**Course outcomes:**

At the end of the subject the students will be able -

1. To understand the basics of material properties, stress and strain.
2. To apply knowledge of mathematics, science, for engineering applications
3. To identify, formulate, and solve engineering & real life problems
4. To design and conduct experiments, as well as to analyze and interpret action and reaction data.
5. To understand specific requirement from the component to meet desired needs within realistic constraints of safety.

**SECTION – A**

**Unit I:** Mechanical properties: Concept of direct and shear stresses and strains, stress-strain relations, Biaxial and triaxial loading, elastic constants and their relationship, stress-strain diagrams and their characteristics for mild steel, tor steel, Generalized Hook's law, factor of safety. Uniaxial stresses and strains: Stresses and strains in compound bars in uniaxial tension and compression, temperature stresses in simple restrained bars and compound bars of two metals only.

**Unit II:** Axial force, shear force & bending moment diagrams: Beams, loading and support conditions, bending moment, shear force and axial load diagrams for all types of loadings for simply supported beams, cantilevers and beams with overhangs, relation between shear forces, bending moment and loading intensity.

**Unit III:** Stresses in beams (Bending, Shear), i) Bending: Theory of simple bending, section modulus, moment of resistance, bending stresses in solid, hollow and built up section. ii) Shear: Distribution of shear stresses on beam cross sections, impact loads and instantaneous stresses.

**SECTION – B**

**Unit IV:** Torsion: Theory of torsion & assumptions, derivation of torsion equation, polar modulus, stresses in solid & hollow circular shaft, power transmitted by shaft, closed coiled helical spring with axial load. Thin cylinders subjected to internal pressures.

**Unit V:** Principal stresses: Biaxial stress system, principal stresses, principal planes, Mohr's circle of stresses, principal strains. Combined direct & bending stresses.

**Unit VI:** Slope & deflection of beams: Slope & deflection in statically determinate beams subjected to point loads, uniformly distributed loads, moments by Macauley's method. Theory of long columns, Euler, Rankin's formula.

**Books Recommended:**

1. E. P. Popov, "Mechanics of Materials", Prentice Hall of India, New Delhi.
2. S. Timoshenko and O. H. Young, 'Elements of Strength of Materials', East West Press Private Ltd., New Delhi.
3. Ferdinand L. Singer, 'Strength of Materials', Harper and Row, New York.
4. Shames, I. H., 'Introduction to Solid Mechanics', Prentice Hall of India, New Delhi.
5. R. K. Bansal, Strength of materials, Laxmi Publications Pvt Ltd.
6. Junnarkar, S. B., Mechanics of materials.
7. Mubeen, A., Mechanics of solids, Pearson education (Singapore) Pvt. Ltd.
8. Beer and Johnston, Mechanics of materials, Mc-Graw Hill.
9. S. Ramamrutham, Strength of Materials, Dhanpat Rai Publishing Co Pvt Ltd.

**3CT04 APPLIED THERMODYNAMICS**

**Course Learning Objectives :**

1. To study the basic concepts of thermodynamics, thermodynamic systems, work and heat
2. To study the laws of thermodynamics and their applications
3. To study the properties of steam, work done and concept of heat transfer
4. To study the air standard cycles

**Course Outcomes :**

Students will be able to

1. Understand the basic concepts of thermodynamics, thermodynamic systems, work and heat
2. Apply first law of thermodynamics and application of first law to flow and non-flow processes
3. Apply second law of thermodynamics and understand concept of entropy
4. Understand the properties of steam, work done and heat transfer during various thermodynamics processes with steam as working fluid
5. Understand the concept of air standard cycles

**SECTION – A**

**Unit-I:** Introduction to basic concepts of thermodynamics, Macroscopic and microscopic approaches, properties of system, state, processes and cycle, thermodynamic equilibrium, types of thermodynamic systems, Temperatures and Zeroth law of thermodynamics, Quasi-static process, Gas Laws and Ideal gas equation of states, gas constant and universal gas constant.

Work and Heat: Definition of work, thermodynamic work, displacement work and other forms of work, Definition of Heat, Work and heat transfer as path function, comparison of work and heat, work done during various processes, P-V diagrams (10 hrs)

**Unit-II:** First law of thermodynamics: Energy of a system, classification of energy, law of conservation of energy law, Joules experiment. Energy a property of system, internal energy-a function of temperature, Enthalpy, specific heat at constant volume and constant pressure. Application of first law to non-flow processes, Change in internal energy, work done and Heat transfer during various non-flow processes. (7 hrs)

**Unit-III:** First Law applied to flow processes: Steady state, steady flow process, equation for work done in steady flow process and its representation on P-V diagram, mass balance and energy balance in steady flow process, steady flow energy equation and its application to nozzles and diffusers, turbine and compressor pumps, heat exchangers, Throttle valve etc. work done and Heat transfer during steady flow processes. (9 hrs)

**SECTION – B**

**Unit-IV:** Second Law of thermodynamics: Limitations of First law, Thermal energy reservoir, heat engines refrigerator and heat pumps, COP and tonne of refrigeration, COP for heat pump and refrigerator, Kelvin-Planck and Clausius statements, their equivalence, reversible and irreversible processes, Carnot cycle, Carnot theorem and its corollary, The thermodynamic temperature scale, Reverse Carnot cycle, Inequality of Clausius.

Introduction to Entropy, availability and irreversibility. Principle of increase of entropy. (8Hrs)

**Unit-V:** Properties of Steam: Triple point and critical point, Sensible heat, latent heat, superheat and total heat of steam. Wet steam, dryness fraction, Internal energy of steam, External work of evaporation, internal latent heat, Specific volume, enthalpy, internal energy and entropy of steam. T-S diagram Mollier chart, Steam tables and their use. Work done and heat transfer during various thermodynamics processes with steam as working fluid. Throttling of steam, determination of dryness fraction using various calorimeters. (8 Hrs)

**Unit VI :** Air Standard Cycles: Otto, diesel, semidiesel, Brayton, Sterling and joule cycles etc., their efficiencies and mean effective pressure, comparison of auto, diesel and dual cycles.

Vapour Cycles:- Rankine and Modified Rankine Cycle. Comparison of Rankine and Carnot cycle, representation on P-V, T-S and H-S diagram. (No numerical on this unit) (numerical on air standard cycle) (8 Hrs)

**BOOKS RECOMMENDED:**

**Text Books :**

1. Engineering Thermodynamic - by P. K. Nag.
2. Fundamentals of Engineering Thermodynamics; R. Yadav;
3. Thermodynamics Basics and Applied: by V. Ganeshan
4. Thermal Engineering: by Mahesh M. Rathore.

**Reference Books :**

1. Basic Engineering Thermodynamics - by Reyner Joel
2. Thermodynamics - by C.P. Arora.
3. Fundamentals of Classical Thermodynamics - by G. J. Vanwylen.
4. Engineering Thermodynamics; P. Chattopadhyay; Oxford
5. Engineering Thermodynamics; Gordon Rogers, Yon Mayhew; Pearson.

**3CT05 PROCESS CALCULATION**

**Course objectives :**

1. Students will learn the basic and fundamentals of chemical engineering operations and processes.
2. Students will understand the material balance and energy balance of various unit operations and unit processes.
3. Students will learn how to formulate and solve the problems related to material and energy balance with or without chemical reaction.

**Course Outcomes:**

- After successful completion of this course student will be able to
1. Understand the concept of basic chemical calculations
  2. Understand the concept and application of theory of proportions
  3. Determine the humidity with/without using a psychrometric chart.
  4. Make the material balance over unit operations and processes.
  5. Make the energy balance over unit operations and processes.
  6. Solve the problem of fuels and combustion.

**SECTION A**

**Unit I:** Introduction to unit operations and unit processes, Units and dimensions, Atoms, moles and molecular weight, mole and mass fraction, Composition of solids, liquids and gases, Concept of Normality, Molarity and Molality, PPM (Parts Per Million), Ideal Gas Law, Dalton's Law, Partial Pressure, Amagat's Law, Average Molecular Weight, Density of Gas Mixture, Raoult's Law, Henry's Law, Vapour Pressure, Clausius Clapeyron equation, Cox Chart, Humidity and saturation, Humidity Chart, and their application.

**Unit II :** Material balance without chemical reaction stoichiometry and unit operations Distillation, Absorption, Extraction, Crystallization, Drying, Mixing, Evaporation. Recycle, purge and Bypass calculations.

**Unit III :** Material balance involves chemical reaction, Principle of stoichiometry, simple oxidation reaction, multiple chemical reaction, percentage Conversion, percentage Yield, and selectivity, calculation involving combustion of gases, liquid and solid fuel. Recycle, purge and bypass calculations.  
Introduction to unsteady state material balance

**SECTION B**

**Unit IV :** Energy balance: open and closed system, heat capacity, calculations of enthalpy changes, enthalpy changes for phases transitions, evaporation, Solution and mixing, clausius clapeyron equation.

**Unit V:** Energy balance with chemical reaction, calculation of standard heat of reaction, heat of formation, heat of combustion, Hess law, Effect of temperature on heat of reaction; adiabatic flame temperature calculations.

**Unit VI :** Heating value of fuels, calculations involving theoretical and excess air, heat and material balance of combustion processes.

**References :**

1. Bhatt, B. I., Vora, S. M., "Stoichiometry", Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2004.
2. Narayanan K V and Lakshmikutty B, Stoichiometry and Process Calculations, Prentice Hall of India Pvt Ltd, New Delhi 2006.
3. Sikdar, D. C., "Chemical Process Calculations", Prentice Hall of India.
4. Himmelblau, D. M., Riggs, J. B. "Basic Principles and Calculations in Chemical Engineering", Eighth Ed., Pearson India Education Services, 2015.
5. Hougen. O. A, Watson K.M. and Ragatz R.A. "Chemical Process Principles, Part -I, Material and Energy Balance".

**3CT06 APPLIED ORGANIC CHEMISTRY- LAB**

**Course objectives:**

1. Students should be familiar with common organic compounds, should identify them and should know simple organic preparation and separation methods.
2. Students will get introduced to aromatic compounds, heterocyclic chemistry and natural Products.

**Course outcomes:**

1. Students will be able to list steps for identifying simple organic compounds
2. Students will be able to list some methods of separation of organic compounds
3. Student will be able to synthesize simple organic compounds.

**Content:**

1. Identification of an organic compound through elemental analysis, group detection, physical constants (m.p and b.p) and derivatisation.
2. Separation and purification of binary mixtures of the type: water soluble-water insoluble, both watersoluble, liquid-liquid by distillation, dissociation - extraction , crystallization, etc.
3. Simple organic preparations:
  - i) Acetanilide
  - ii) Nitro Acetanilide
  - iii) Aspirin

**Books Recommended:**

1. Practical Organic Chemistry, by I.L. Finar
2. Laboratory hand book of organic qualitative analysis and separation, by Kulkarni V. S. D. Ramchandra & co. Pune.

**3CT07 APPLIED PHYSICAL CHEMISTRY- II - LAB**

Total hours / week : 2  
Total credit: 1

Examination Scheme: (I): 25, (Ext): 25 Marks

**Course Objectives:** To provide the practical knowledge of analysis techniques by classical and instrumental methods for developing experimental skill to built technical competence.

**List of Experiments:**

1. Determination of viscosity average molecular weight of polymer.
2. Determination of order of reaction and specific rate constant of hydrolysis of methyl acetate.
3. Study of kinetics of second order reaction. ( Saponification of ethyl acetate & reaction between potassium per sulphate & potassium iodide)
4. Determination of relative strength of two acids by kinetic study of reaction
5. Determination of energy of activation of reaction
6. Determination of equivalent conductivity of strong electrolytes at infinite dilution.
7. Determination of transport number by EMF measurement.
8. Determination of equivalence point of titration by conductance measurement.
9. Potentiometric titration between strong acid and strong base.
10. Verification of Beer- Lambert's law and determination of concentration of unknown solution.
11. Verification of Freundlich and Langmuir isotherm.
12. Determination of refractive index.
13. Determination of solubility of sparingly soluble salts by EMF measurement.
14. Determination of heat of neutralization & ionization of acetic acid
15. Determination of  $\Delta H$  and  $\Delta S$  of monobasic acid by measuring its solubility at different temperatures.
16. Determination of specific rotation of cane sugar by polarimetry.

All above experiments are to be arranged in the laboratory. Minimum 08 experiments are required to be performed by the student to complete the term work.

**Course outcomes:** After completion of this course the students shall be able to :

1. Understand the objectives of their experiments.
2. Follow the proper and safe procedure to get the accurate results.
3. Record and analyze the results.
4. Interpret the results through proper writing in laboratory journal

**Books Recommended :**

1. Experiments in Physical Chemistry, David P. Shoemaker, Carl W. Garland, Jeffrey I. Steinfeld
2. Experiments in Chemistry, Dr. D. V. Gahagirdar, Himalaya Publishing House
3. A Text Book of on experiments and calculations- Engg. Chemistry, S.S. Dara, S. Chand & Comp. ltd.

3CT08 / 3CH08 – STRENGTH OF MATERIALS – LAB

List of Practical's in Strength of Material Lab (Minimum any eight practical from the list should be performed)

1. Tension test on metals.
2. Compression test on metals.
3. Shear test on metals.
4. Impact test on metals.
5. Hardness test on metals.
6. Torsion test on metals.
7. Deflection of beams.
8. Modulus of rupture test.
9. Buckling of columns.
10. Deflection of springs.

3CT09 APPLIED THERMODYNAMICS – lab.

Minimum 8 10 10 Practicals based on the Syllabus 3CT09 APPLIED THERMODYNAMICS.

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SEMESTER - IV

4CT01 MATHEMATICS - II

Course Outcomes:

After successfully completing the course, the students will be able to

1. Demonstrate the knowledge of partial differential equations, applied to Computer technology.
2. Find roots of complex numbers, separate the complex quantity in real & imaginary parts, and find logarithms of negative numbers and complex quantities.
3. Compute different Numerical Methods
4. Analyze the Knowledge of Optimization.
5. Analyze the concept of Linear Programming Problems and Simplex Method
6. Demonstrate the basic concepts of probability and statistics

Students are expected to be aware of the statements of the relevant theorem without mastering their proofs.

**Unit I : Partial Differential Equations** : Basic concepts (@J 1.1), Vibrating string (@11.2), separation of variables (@11.3), one dimensional heat flow(@11.5), 11.6) (07 periods)

**Unit II: Complex Numbers and Analytic functions** : Complex numbers(@12.1), polar form(@12.2), Complex function limit, derivative analytic function (@12.4), Cauchy Riemann Equations, Laplace's Equation(@12.5), rational functions(@12.6), Exponential function (@12.7), Trigonometric and hyperbolic functions (@12.8), [logarithm \(@12.9\)](#) (07 periods)

**Unit III : Numerical Analysis** : Errors in computation (@19.1), Solution of Equations by iteration, Newton - Raphson method (@19.2) Finite differences{@19.3}, Interpolation (@19.4), Numerical integration using rectangular, trapezoidal and Simpson's rule (07 periods)

**Unit IV : Optimization** : Basic concepts (@22.1), Linear programming{@22.2}, Simplex method{@22.3},(@~2.4) (07 periods)

**Unit V : Probability and Statistics** : Sample mean and variance (@23.3), probability (@23.S), Permutations and combinations (@23.6), discrete and continuous distributions (@23.7), mean and variance of a distribution (@23.8), Binomial, Poisson distributions (@23.9), Normal distribution (@23.10) (07 periods)

**Unit VI : Probability and Statistics** (continued) : Random sampling (@23.12), Estimation of parameters (@23.13), confidence intervals (@23.14), Testing of hypothesis (@23.15) (07 periods)

**Note** : Numbers in bracket refer to section number; T1 "Advanced Engineering Maths" by Erwin Kreyszig (Finn jdn), Wiley Eastern.

**Books Recommended :**

- 1) Elements of Applied Mathematics: P.N. Wartikar & J.N. Wartikar,
- 2) A text book of Applied Mathematics: P. N. Wartikar & J. N. Wartikar,
- 3) Advanced Engg. Mathematics - Erwin Kreyszig, Wiley Eastern (5th Edition),
- 4) Higher Engg. Mathematics . B.S.Grewal.
- 5) Numerical Method for Mathematics Science and Engineering, John H. Mathew, PHI
- 6) 4. Numerical Methods - Principles, Analysis & Algorithms Pal, Oxford.

**4FT02 FOOD TECHNOLOGY-I:**

**CHEMISTRY OF FOODS :**

Development of Food Chemistry : History of Food Chemistry. Nature and Origin of life. Basic activities of animals and plants and their relations. Water and Ice: Importance of water in foods. Structure of water and ice. Concept of bound and free water and their implications.

**Carbohydrates** :- Nomenclature, Classification and structure of Carbohydrates. Chemical reactions of carbohydrates. Physical and Chemical properties of sugars, starch, pectic substances, gums and other polysaccharides, Functional properties of carbohydrates in foods.

**Lipids:** Definition and classification of lipids, Chemistry of fatty acids and glycerides, Physical and chemical characteristics. Chemistry of processing of fats and oils, hydrogenated fats, shortening agents and confectionery fat etc. Rancidity of fats and oils, its prevention and antioxidants. Functional properties of lipids in foods.

**Protein:** Importance of proteins. Nomenclature, classification, structure and chemistry of amino acids, peptides and proteins Sources and distribution of proteins. Isolation identification and purity of proteins, Denaturation Functional properties of proteins in food.

**Fruits and Vegetables:** Plant Cells and tissues, their structure, functions and physiology, Chemical Composition of edible plant tissue. Texture of fruits and vegetables. Effects of cooking on texture and composition of fruits and vegetables.

**Meat. Fish and Poultry :** Animal Proteins, Structure and chemical composition of muscles, **Myoglobin and hemoglobin** - Post - Mortem changes regor mortis. Methods of cooking and processing and their influence on texture. Physical and chemical changes during cooking Palatability characters; texture and tenderness. Structure and composition of eggs. Chemistry and functional properties of eggs.

**Milk and Milk Products :** Composition of milk, Physical and chemical properties of milk protein and effects of processing on these. Chemistry of milk product like cheese, cream, butter, ghee etc

**Miscellaneous:** Sensory perception of tests and flavors. Browning reactions, Nutritive and non-nutritive sweeteners. Food dispersions and their implications on foods.

**Books Recommended :**

1. Food Chemistry by L.H. Meyer, Publishers, Van Nostrand Reinhold Co. New York, Latest Edition.
2. Principles of Food Science- Edited by Owen R. Fennema, Part I Food Chemistry, Publishers Marce Dekker, Inc. New York.
3. The Chemical Analysis of Foods and Food Products : Morris, B.Jacobs 3rd Edition, Publishers Van. Nostrand Company, INC. Princeton, New.
4. Introduction to the Biochemistry of Foods by J..B.S. Braverman, Publishers Elsevier Publishing Co. Amsterdam, Latest Edition.
5. The Spice Hand Book by J. W.Patty, Publishers Chemical Publishing Co. Inc. New York, Latest Edition.
6. Food Theory and Application by Paul, Pauline and Palmer, Helen H., Publishers, John Wiley and Sons. New York,. Latest Edition.

**4PT02 PULP AND PAPER TECHNOLOGY-I**

**CHEMISTRY OF WOOD AND PULP OF PAPER MATERIALS:**

**Species, anatomy and physical properties of Wood:-**

Classification of woods, plants used in pulp and paper, gross structure of trunk, structure elements of wood, fiber dimensions water conducting system, food conducting system, reactions of wood, bark and its structural elements, dec of wood, physical properties of wood. Fiber morphology: Cell formation and growth, fiber structure, chemical composition of wood, non-wood fibers used in pulping bast, fruits, grass, leaf, animal, mineral and synthe: icfibers

**Cellulose:** Chemistry and location in the cell, isolation molecular constitution, microfibrils, crystalline and amorphous Pulp of Paper biogenesis of the cell wall, Polysacchrides, sorption, swelling and solution of cellulose, degradation reactions of pulp of paper.

**Hemicelluloses :** Structure and properties of hemicelluloses.

**Lignin:** Lignification in wood, biological and biochemical aspects of lignin information, structure and properties of lignin, separation of lignin from woody tissues and Fiber laboratory separation, commercial separation, analysis of lignin and utilization of Lignin.

**Books Recommended :**

1. "The Chemistry of Cellulose" by Emil Hauser, John Wiley & Sons, New York.
2. "The Methods of Cellulose Chem. " by Charles Dorce, Chapman & Hall, L.
3. High Polymers Vol V (Part-I to V) edited by Emil Ott & Others, Interscience Publishers.
4. Publishing Processes by S.A. Rydholm, John Wiley & Sons, Inc., New York.
5. Pulp & Paper : Chemistry & Chemical Technology by James P. Cascy.

**4OT02 OIL & PAINT TECHNOLOGY-I**

(CHEMISTRY OF OIL AND FATS & INTRODUCTION OF PAINTS )

**Natural Fats :** Their Sources, classification and composition Constituents of natural fats : Glycerides, Phospholipids, Fatty acids, non-glycerides constituents, toxic constituents and detoxication, Nutritional functions of Fats. **Glycerides and fatty acids :** Nomenclature, Structure, occurrence in fats. Physical properties of fats and fatty acids. Elementary ideas on their liquid properties, solution properties and spectral properties.

**Chemical reaction of fats and their fatty acids.** Chemistry of hydrogenation, hydrogenolysis, autoxidation, polymerisation dehydration, pyrolysis, halogenation, sulption and sulphonation , esterification , interesterification and hydrolysis. Chemical Oxidation of fatty acids, Significance and importance of these reactions. Rancidity Of Oils & Fats, . Oils Antioxidant and Synergists.

**Physical and Chemical characteristics :** Indian standards for oils and fats - ISI Specifications of Oilseeds, Oils, DOC, Vegetable Ghee . Identification of fats. Detection of adulteration in fats and Indian standards for oils and fats. **Introduction of Paints,** Types Of Paints, Basic Ingredients of Paint System, Industrial Applications of Paints , Recent development in the field of Oils & Paints.

**Books Recommended :**

1. Industrial Oil and Fat Products Ed. : A.E. Bailey. Interscience & Sons New York, London, Sydney 5<sup>th</sup> Edn.
2. An Introduction of the Chemistry and Biochemistry of Fatty Acids : Gumstone.
3. Progress in the Chemistry of Fats and other liquids (Vols. 1 to 11) T.R. Holmann, Pergamon Press.
4. Fatty Acids : K.S. Markley, Inter Sc. Publishers, 2nd edition, New York.
5. Industrial Chemistry of Fats and Waxes : T. Hilditch Balliere Tindall and Cox, London 2nd Edition.
6. Rancidity of Edible Fats : C.H. Lea, His Majesty's Stationary Office, London, Latest Edition.
7. Analysis of Fats and Oils : V.V. Mellen Bacher, Garrard Press Publishers, Illinois, Latest Edition.
8. Outline of Paint Tech. - H. Hea
9. Introduction of paints by Morgan.

**4PC02 PETROCHEMICAL TECHNOLOGY - I**

**Course Objectives:** Basic Concepts of Chemistry of Hydrocarbons, Introduction to Basic Refinery Processes. Formation Theories of Petroleum. Exploration and prospecting for petroleum and gas field, Drilling. Transportation, Storage of Petroleum & Products and future Energy Sources.

**Course Outcomes:**

- 1) Students will be able to understand the chemistry and composition of petroleum.
- 2) Students will be able to understand the importance petroleum as a source of energy and petrochemicals
- 3) Students will be able to understand the technology involved in exploration and prospecting for petroleum and gas field, as well as drilling for petroleum.

**Unit-I:** Origin, Occurrence, and Formation of crude petroleum. History of Indian Petroleum and Refining Industry and future trends. Hydrocarbon resources in India, history. World Petroleum Scenario, world Petroleum Reserves and Deposits. Crude Oil and Natural Gas Production and Consumption in India. Petroleum refineries in India, their location, year of commissioning, and organizations, Refining Capacity & throughput, Production & Consumption of Petroleum Products. Advantages and disadvantages of petroleum.

**Unit-II:** Composition, Chemistry, Classification of Petroleum Hydrocarbon composition of petroleum and petroleum products (liquid and gas). Non-hydrocarbon compounds in petroleum. Properties of hydrocarbons and non-hydrocarbons. Classification and description of crude oils and petroleum gases.

**Unit-III:** Refining Processes and Operations Various refining processes, operations and chemistry involved. Principle involved in dehydration, desalting and conditioning of crude oil. Thermodynamics, kinetics and reaction mechanism, principle involved in thermal and catalytic processes such as thermal and catalytic cracking, hydro cracking, reforming, isomerisation, polymerization, alkylation.

**Unit-IV:** Exploration and prospecting for petroleum and gas field Structure of earth and of the earth crust, formation of Sedimentary rocks, Exploration and prospecting for petroleum and gas field, Geological, Geophysical, Geochemical prospecting methods, geophysical borehole logging methods. Migration of petroleum and gas deposits and commercial petroleum accumulations. Petroleum traps and their classifications. Development of an oil or gas field.

**Unit-V:** Drilling for Petroleum Drilling operation, Cable tool method, Rotary drilling, Turbo drilling, types of drill bits, mud fluids, casing off formations, Deviation of holes, Directional drilling, Offshore drilling rigs, Well control systems.

**Unit-VI :** Other Sources of Hydrocarbons, Transportation & Storage of Petroleum Sources of hydrocarbons other than crude oil, future automotive fuel resources, new and future energy sources. Transportation and storage of crude oil, petroleum gases, and petroleum products. Shipping tankers, Pipelines: Materials and Corrosion, Onshore and offshore pipeline construction. Pipeline network in India.

**Books Recommended :**

- 1) Modern Petroleum Refining Processes by B. K. BhaskaraRao, Latest Edition.
- 2) Chemistry of Petrochemical Processes by Sami Matar, Lewis F. Hatch
- 3) The Chemistry and Technology of Petroleum by James G. Speight
- 4) Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri
- 5) Modern Petroleum Technology Volume-I Upstream Edited by Richard A. Dawe

4 CT03 / 4CH02 MACHINE DESIGN & DRAWING

SECTION - A

**Unit I-** (a) Sectional Views Conversion of pictorial view in to sectional orthographic projections, Sectional views with different types of projections, Missing views (12 Hrs)

**Unit II-** a) Development of surfaces 31 32 Development of surfaces of cubes, prisms, cylinders, pyramids, cones & their cut sections

b) Intersection of solids-prism and prism, cylinder and cylinder, cylinder and prism, cone and cylinder, cone and prism. (12 Hrs)

SECTION B

**Unit III-** (a) Meaning of Design, Phases of Design, Design considerations.

(b) Simple stresses, Thermal stresses, Torsional Stress, stresses in straight & curved beams and its application- hooks, cclamps

(c) Design & drawing of riveted joints- Caulking & fullering, failures, strength & efficiency of riveted joints.

(d) Welded joints- Symbolic representation, Strength of transverse & parallel fillet welded section e) Design & drawing of Knuckle Joints (12 hrs)

**Unit IV :**(a) Design of Helical springs- Types of springs, stresses in helical springs, Wahl's stress factor, Buckling & surge, tension spring (b) spiral & leaf springs c) Design of power screw-Torque required to raise loads, efficiency & helix angle, overhauling & self locking of screw, acme threads, stresses in power screw. (12 hrs)

**Books Recommended :**

**Text Books :**

- 1) Machine Drawing by N. D. Bhatt, Charator Publication
- 2) Machine Design by R. S. Khurmi & J. K. Gupta , S. Chand Publication .

**Reference Books :**

- 1) Machine Design by Dr. P. C. Sharma & Dr. D. K. Agrawal, Katsons Books publication
- 2) Design of Machine elements by C. S. Sharma, Kamlesh Purohit, PHI publication
- 3) Design of Machine elements by V. B. Bhandari, Tata McGraw Hill Publication
- 4) Machine Design, Jindal, Pearson publications
- 5) Design Data Book by- P.S.G. Koimbatore
- 6) Design Data Book by Mahadevan.

(Use of any data book from the above will be permitted during the examination).

4CT04 MATERIAL SCIENCE & ENGINEERING

SECTION-A

**Unit I :** Crystalline and non crystalline structure sensitive and insensitive properties and defects in crystals. Co-relation of mechanical properties with reference to structure.

**Unit II:** Effect of temperature on mechanical properties various methods of improving the strength failure under service conditions

**Unit III :** Solid solutions phase diagrams and their relation to meta properties with reference to steels and cast irons.

SECTION-B

**Unit IV :** Heat treatment of steels and common on ferrous alloys.

**Unit V:** Elastomers and plasiomers, molecular structure and properties of polymers, ceramic materials and refractoriness, High temperature oxide ceramics glasses and their properties, composite materials.

**Unit VI :** Corrosion: Electrode potentials e.m.f and galavanic series, polarization forms of corrosion, rate factors, inhibition, prevention, control and testing, Corrosion behaviour of metals and alloys chemical resistance of polymers, Forming processes and corrosion. Non destructive methods of testing, Metallic, Plastic and other protective coatings.

**Books Recommended :**

1. Nature and properties of Engineering Materials by D.Jastrebski.
2. Introduction to Materials science by Guy.
3. Material Science and Processes by SK.Hajra Chaudhry
4. Material Science for Engineers by Van Valack.

**4CT05 FLUID FLOW OPERATION**

**Course Objectives:**

1. Students will understand the basic concept of fluid flow, types of flow, and application of fluid mechanics.
2. Students will get the knowledge of flow and pressure measurement using different flow meters, and pressure measuring devices.
3. Students will get the knowledge of various pumps used in chemical industries.
4. Students will get the knowledge of various agitators and mixing equipments and power consumption for mixing.

**Course Outcomes:**

After successful completion of this course student will be able to

1. Understand the knowledge of fluid flow, fluid properties and type of fluid
2. Understand the concept of dimensional analysis
3. Select the agitators for mixing operations and able to calculate the power required for mixing.
4. Understand the concept and applications of Bernoulli's theorem,
5. Understand the principle, working and application of different flow meter
6. Understand the principle, working and application of various pumps and able to calculate the power requirement and NPSH of centrifugal pump.
7. Calculate the pressure drop across packed bed and minimum fluidization velocity in fluidized bed; understand the concept of two phase flow.

**Course Contents:**

**Unit I** :Properties of fluid and their classification : Fluid statics: Forces on fluids, pressure depth relationship for compressible and incompressible fluids, forces on submerged bodies. rigid body motion, pressure measurement, Euler's equation.

**Unit II** :Kinetics of flow, Description of velocity field, Stream functions, angular velocity, Fluids in circulation, Irrational flow. Dimensional analysis: Buckingham Pi theorem, dimensionless number and their physical significance, simulated criteria. Mixing and agitation of fluid, types of mixers and their selection, power requirement.

**Unit III** :Fluid flow: Laminar and turbulent flows, pressure drop in pipes and tubes, pipe fitting and pipe network and friction factor, conversion of mass Momentum and energy, Navier-Stokes equation, mechanical energy balance and Bernoulli's theorem.

**Unit IV** :Flow measuring devices for chemical plants: Orifice metre, Nozzle Venturimeter, Rotameter and pitot tube.

**Unit V** :Pumping and compressing of chemicals and gases, reciprocating pump, rotary pump, centrifugal pump and blowers. NPSH and calibrations. Mixing and agitation fluids. Compressible fluid flow and Aerodynamics.

**Unit VI** :Flow past immersed bodies, flow through packed bed and fluidized bed, Introductory concept of two phase flow.

**Text Books/ Reference Books :**

1. R. P. Vyas, Fluid Mechanics, Central Techno Publications, Nagpur.
2. W. L. McCabe, J. C. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, McGraw-Hill International Edition 2005.
3. Chemical Engineering volume 1 coulson J. M. and Richardson J. F. Butterworth Heinemann, Oxford
4. M. White, Fluid Mechanics, 8th Edition, Tata-McGraw Hill, 2016.
5. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall of India, 2005.
6. R. W. Fox, P. J. Pritchard & A. T. McDonald, Introduction to Fluid Mechanics, 7th Edn, Wiley-India 2010.

#### **4 FT 06 FOOD TECHNOLOGY - I –LAB**

General methods of proximate analysis of food materials. Analysis of Oils and Fats, Chemical Analysis of carbohydrates and proteins, taniles vitamaries etc. colorimetric methods for starch. and qualitative detection of carbohydrates and proteins, taniles, vitamins etc. Colorimetric methods for starch, polyphenols, carotenes Xanthophylls etc. Paper chromatography and qualitative detection of carbohydrates, proteins and, tats oils, Colour. test for oil. Qualitative and quantitative analysis of acided and antioxidates. Chemical Preservations like benzoic acid and sulfur dioxide, Non-Nutritive Sweetness and emulsifying agents.

#### **Books Recommended :**

1. The Chemical Analysis of Foods, Sixth Edition by David Perason, J.O.A. Churbcill, 104 Gloucester place London. 70
2. Manual of Analysis of Fruits and Vegetable Products: S.Ranganna, Ph.D. Central Food Technological. Research Institute, Mysore, Publisher, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Food Analysis by A.G. Woodman, 4th Edition, Publishers, Mc.Graw Hill Book Company, INC, New York and London, Latest Edition.
4. Modem Food Analysis by F.Leslie Hart A.N. and Hary John Stone Fishes. Ph.D. Publishers, Springer - Verlag, Berlin Heidelberg, New York, Latest Edition.
5. Food Analysis by RLees, Published by Leonard Hill Books, London.
6. Official Methods of Analysis of Association of Official Analytical Chemists, Pub.Associ. Office, Anal, Chemist, Washington D.C. Latest Edition.
7. Approved Methods of the American Association of Cereal Chemist, Vols. I & II, Latest Edition. Published by American Association of Cereal Chemist inc. Paul, Minnesota U.S.A.

#### **4 PT 06 PULP & PAPER TECHNOLOGY-I - LAB**

Determiration of various components of wood such as moisture content.ash content, Water Solubility, alkali, solubility extractives, lignin Cellulose; hemicellulose, holo cellulosepentosans etc. Microscopic observations of fibrous materials.

#### **4 OT 06 OIL AND PAINT TECHNOLOGY-I – LAB**

Preparations & Standardization Of Solutions, Determiration of various Physical and Chemical characteristics of oils, fats and waxes, colour, solubility and thermal test for purity. Analysis of oilseeds and cakes, estimation of rancidity. Analysis of nickel catalysts and acid oils determination, Physical and Chemical, characteristics of vanaspati, margarine and ghee. Detection of adulteration in oils & fats Testing of readymade Paints & Raw materials of paints systems like pigments, Solvents, additives, Resins .

#### **4 PC06 PETROCHEMICAL TECHNOLOGY- I –LAB**

#### **Course Objectives:**

Petrochemical Technology lab provides students first handexperience of conducting preliminary tests for various petroleum products and verifying various standard tests and test methods setfor petroleum products and comparing and studying the standard specifications set for petroleum products.

#### **Contents:**

Experiments for Petrochemical Technology-I (Chemistry of Petroleum Hydrocarbons) such as Flash Point by Abel’s Method, Flash Point by Pensky Martien’s Method, Flash and Fire Point by Cleveland Open Cup Method, Smoke Point, Aniline Point, Cloud and Pour Point, API Gravity, Viscosity (by Redwood Viscometer/Saybolt Viscometer/Engler Viscometer), Copper Strip Corrosion, Drop Melting Point of Wax, Melting Point of Wax by Cooling Curve Method, Congealing Point of Wax etc.

**Lab. Outcomes :**

Students will be able to:

- Learn how to experimentally verify various theoretical concepts.
- Visualize practical testing of petroleum products under standard test conditions.
- Develop experimental skills.

**4 CT07 MACHINE DESIGN & DRAWING –LAB**

**Minimum 8 to 10 practicals based on the Syllabus 4 CT04 MACHINE DESIGN & DRAWING**

**4 CT08 MATERIAL SCIENCE & ENGINEERING – LAB**

Ten experiments based on the above syllabus evenly distribute shall be performed and a report/journal there of submitted by each student. The practical Examination shall consist of practicals and viva voce based on the syllabus and practicals.

**4 CT09 FLUID FLOW OPERATIONS – LAB**

**List of Practicals :**

1. Calibration of Venturi metre
2. To obtain the coefficient of discharge for the given orifice meter
3. To study the types of flow and determine critical Reynolds number.
4. To verify Bernoulli's theorem.
5. To study the centrifugal pump
6. To study the reciprocating pump
7. To study the loss of head due to Pipe Friction
8. To study the Loss of head due to Pipe Fittings

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