S.Y. B.Tech. (Chemical Engineering) Curriculum Structure: CBCS - I, Academic year 2015-16 onwards

Semester III								
Course Code	Course Title	Cat Code	Lectures (L)	Tutorials (T)	Practical (P)	Credits		Total
						Th.	Pr.	
MA201	Engineering Math-III	**BS**	04	--	--	04	--	4
CH201	Applied Physical Chemistry	**BS**	03	--	02	03	01	4
CH202	Fluid Particle Mechanics	**PC**	04	--	02	04	01	5
CH203	Chemical Process Calculation	**PC**	03	01	--	04	--	4
CH204	Chemical Engineering Thermodynamics-I	**PC**	03	01	--	04	--	4
UHS222	Professional Communication	**HS**	02	--	02	02	01	3
		Total	19	02	06	21	03	24
Sub Total			27					**24**

Semester IV								
Course Code	Course Title	Cat Code	Lectures (L)	Tutorials (T)	Practical (P)	Credits		Total
						Th.	Pr.	
MA202	Engineering Math-IV	**BS**	04	--	--	04	--	4
CH205	Inorganic Chemical Technology	**ES**	03	--	02	03	01	4
CH206	Organic Chemical Technology	**ES**	03	--	02	03	01	4
CH207	Mechanical Operation	**ES**	03	--	02	03	01	4
CH 208	Chemical Engineering Thermodynamics-II	**PC**	03	--		03	--	3
CH209	Machine Design & Drawing	**ES**	02	--	02	02	01	3
UHS221	Human values and professional Ethics (HVPE)	**HS**	02	--	--	02	--	2
		Total	20	--	08	20	04	24
Sub Total			28					**24**
Total Credits			**24+24 =48**					

MA201	**Engineering mathematics-III (Differential Equation**) 4-Credit (L-4,T-0,P-0)

Course objectives:

To acquaint student with: the basic concepts of an ordinary differential equations, partial Differential equations, Mathematical Modeling in physical problems. Initial and boundary value Problems. Motivate students to use critical thinking skill to solve practical problems

Course Outcomes: At the end of the course the student is expected to understand:

- Importance of differential equations i.e. ODE and PDE in physical problems.
- Able to solve IVP in electrical and mechanical problems.
- Analyzing physical phenomena in engineering and technology by using this theory

COURSE CONTENT

Unit-1

Basic Concepts & Ideas, Geometric Meaning of $y' = f(x, y)$, direction field , exact equations, Integrating factors, Linear differential equation, Bernoulli's equations, orthogonal trajectories, applications to electrical circuits.

Unit-2

Second Order Differential equations, Homogeneous linear differential equation for real & complex roots, Euler Cauchy equation, existence & uniqueness theorem (Without proof) & Wronskian.

Unit-3

Non homogeneous equation, solutions by undetermined coefficients & Variation of parameter methods, modeling, forced oscillation, resonance & electrical circuits, system of differential equations.

Unit-4

Fourier Series, Periodic function, Fourier theorem Euler's formulae for the Fourier coefficients, convergence of Fourier series , change of interval , even & odd function functions , half range Fourier series.

Unit-5

Partial differential equations , Separation of Variables , Vibrations of string, one dimensional equation

Text/Reference Books:

- Advanced Engineering Mathematics – R.K Jain & S.R.K Iyenger
- Advanced Engineering Mathematics- Erwin Kreyszig
- Elementary Differential Equation(eighth edition) W.E Boyce & R. Diprima (John Wiley 2005)
- Fourier series & boundary Valued Problems., R.V Churchill & JW Brown(Seventh edition) Mc Graw Hill(2006).

CH201	**Applied Physical Chemistry: 4-Credit (L-3,T-0, P-2)**

Objectives:

- Information of process such as Adsorption, Conductivity and their application.
- Basic concepts of Physical process become clean.
- Get idea to determine order of chemical reaction.

Outcomes:

- Basic concepts of different physical processes become clear.
- Understand the determination of order of reaction.

COURSE CONTENT

1. **Chemical Kinetics & Equilibrium**: Order and Molecularity of reaction, rates of reaction, factor affecting, first and second order reactions with derivation, Theories of reaction rates collision and transition state theory, pseudo unimolecular reactions, determination of rates of reaction, numerical. The law of Chemical Equilibrium, Lech atelier's principle , solubility and distribution law, explanation and limitations of distribution law, Henry's law, determination of equilibrium constant from distribution coefficient, numerical.
2. **Photo chemistry:** Introduction, laws of photochemistry, quantum efficiency, kinetics of photochemical reactions, photochemical, photosensitized reaction, photochemical phenomenon, photosynthesis.
3. **Catalysis & Surface Chemistry:** Definition, characteristics, types of catalysis, theory of catalysis, (acid/base) catalysis, Enzyme Catalysts (biocatalysts), mechanism of catalysis. Terminology, Factors affecting the adsorption of gases by solids, Types of adsorption. Adsorption isotherms, Langmuir theory of adsorption of a gas on the surface of solids, Ion –exchange absorption, application of adsorption.
4. **Conductometry:** Electrolytic Conductance by solution (Specific, equivalent) factors influencing conductance cell constant, measurement of conductance, conduct metric titrations.
5. **Electro Chemistry :**Introduction, Electro-Potential and its measurement , Nernst Equation, Importance of reduction electrode potential, Electro-chemical cell, Determination of free energy from cell potential measurement, Temperature dependence of EMF, Determination of entropy, enthalpy changes from cell potential measurement, Types of electrode, Commercial electro chemical cell
6. **Volumetric analysis**, concentration of solutions (molarity, normality, molality, equivalent weight, strength of solution) normality equation, numerical based on calculation of strength.
7. **Kinetic Theory of gases**: Kinetic gas equation, equi partitioning of energy Distribution of molecular velocities in three dimensional spaces, typesof molecular velocities, Application of kinetic molecular theory.

Reference/Text books:

- Glassstone S.G.: Physical Chemistry, D.VanNostrand, New York, New York.
- Puri B.H. nad Sharma L.R.: Principles of Physical Chemistry, S Chand & Co., New Delhi.
- Sheenhan W.F.: Principles of Physical Chemistry, Prentice Hall of India Pvt. Ltd. New Delhi
- Dryden C.E., Outline of chemical technology: East West Press.
- Bhal&Tuli: Essentials of Physical chemistry, S Chand & Co., New Delhi.
- A.S. Negi and S.C.Anand: A Textbook of Physical Chemistry, New Age International

Lab Work:

1. Determination of reaction rate constant of catalyzed hydrolysis of methyl acetate in N/2 HCL.
2. Determination of reaction rate constant of catalyzed hydrolysis of methyl acetate N/2 H2 SO4.
3. To determine partition coefficient of benzoic acid in benzene and water.
4. To determine partition coefficient of iodine in carbon tetrachloride and water.
5. Determination of reaction rate constant of reaction between k2s2o8 and KT.
6. To verify freundlich adsorption isotherm by adsorption of acetic acid on charcoal.
   (a)Preparation of standard solution of oxalic acid and (b) Standardization of NaoH solution.
7. To determination of the amount of oxialic acid and sulphuric acid in 1 liter of solution

given 0.1 N NaOH solution and 0.1 N $KMNO_4$ solution.

8. To determine the amounts of Na_2Co_3 and $NaHCO_3$ in the given alkali mixture of Solution.
9. Verification of Lambert Beer's Law.

CH202	Fluid Particle Mechanics : 5- Credit (L-4, T-0, P-2)

Objectives:

- Fundamentals of fluid flow, Fluid statics, types of fluids, measuring elements for hydrostatic pressure.
- Behavior of flowing fluid, Basic equation of fluid flow, flow of compressible and incompressible fluid.
- Performance of pump and its characteristics.
- Major and minor energy losses in pipes & pipe fittings.
- Various valves and their application, measuring devices for flow.

Outcomes:

- Get familiar with the fundamentals, able to generate velocity profile for the given condition.
- Calculate the flow rate of flowing stream, pressure drop and losses occurring in pipes.
- Students will be able to use the theoretical knowledge in the practical.

COURSE CONTENT

1. **Fluid Statics and its Applications**: Nature of fluids, Hydrostatic equilibrium, Barometric equation, Hydrostatic equilibrium in centrifugal field, Pascal's Law and Hydrostatic equation, absolute and gauge pressures, Manometers, Types of Manometers, Numericals

2. **Fluid Flow Phenomena**: Behavior of flowing fluid, Types of flow, Newtonian and Non-Newtonian Fluids, viscosity and momentum flux, viscosities of gases and liquids, Turbulence, Reynolds experiment, Eddy viscosity, Flow in boundary layers, Laminar and Turbulent flow in Boundary layers, Boundary layer formation in straight tubes, Boundary layer separation and wake formation.

3. **Basic Equations of Fluids Flow**: Mass balance, mass velocity, momentum balance, Bernoulli's equation without and with friction, Eulers equation, Venturimeter, orifice meter, pitot tube, Problems.

4. **Flow of Incompressible Fluids in Conduits and Thin Layers**: Shear stress distribution in a cylindrical tube, relation between skin friction and wall shear, the friction factor. Relations between skin friction parameters. Laminar flow in pipes, Laminar flow of Newtonian fluids. Average velocity, kinetic energy correction factor (Derivation), Momentum correction factor (Derivation), Hagen-poiseuilie equation. Turbulent flow in pipes and closed channels. Velocity distribution for turbulent flow, universal velocity distribution equations for laminar sub layer and buffer layer, Relations between maximum and average velocities, Effect of roughness, The friction factor chart (Moody's diagram), friction factor in flow through channels of non-circular section, friction from changes in velocity or direction, Effect of fittings and valves, couette flow, Layer flow with free surfaces, Problems.

5. **Flow of Compressible Fluids**: Mach number, continuity equation, Total energy Balance, velocity of sound, ideal gas equations, stagnation temperature.

6. **Flow past Immersed Bodies**: Drag coefficients of typical shapes, form drag and stream lining, Friction in flow through beds of solids, Erguns equation, Kozeny- Carman equation Burke Plummer equation, Fluidization, Mechanism of fluidization, particulate and aggregative fluidization, minimum fluidization velocity, expansion of –fluidized beds, and application of fluidization.

7. **Transportation and Metering of Fluids**: Pipe and tubing, joints and fittings. Prevention of leakage around moving parts. Valves- Gate valve, globe valve, check valve butterfly valve, needle valve, ball valve etc Measurement of flowing fluids., Classification and performance of Pumps, Turbines, Compressors, Blowers, Selection and specification, Net positive Suction Head.

Reference/Text books:

- Mc. Cabe, W.L. Smith, J.C. Hariott: Unit Operation of Chemical Engg. McGraw Hill
- J.M. Coulson, J.F. Richardson: Chemical Engg., Vol. 1, Pergamon.
- Foust, A.S Wensei, L.A: Clump Principels of Unit Operation, John Wiely.
- Baoger, W.L. and Banchero, J.T: Introduction to Chemical Engg. McGraw Hill
- Fox, R.W and Mc Donald A.T: Introduction to Fluid Mechanics 4th Eds John Wiley and sons 1996.
- Chattopadhya, P.: Unit Operations of Chemical Engg.

Lab Work:

1. To verify Bernoulli's Equation.
2. To determine the coefficient of friction for pipes of different materials.
3. To study the Operation and working of Drag Coefficient Apparatus.
4. To study the Operation and working of Pitot tube.
5. To determine Reynolds's No and hence the type of flow either Laminar or Turbulent.
6. To conduct an experiment on flow of water through a fluidized bed.
7. Flow measurement by orifice meter.
8. Flow measurement by venturimeter.

CH203	**Chemical Process Calculation: 4-Credit(L-3, T-1,P-0)**

Objectives:

- To understand basic chemical engineering calculations.
- To know the unit systems, conversions.
- 3. To Perform material balance and energy balance calculations on chemical process.

Outcomes:

- Basic concepts regarding chemical engineering calculations become clear.
- 2.Understand the unit systems , conversions, material balance and energy balance calculations on chemical process

COURSE CONTENT

1. **Basic Chemical Calculations**: Units and Conversions, Pressure, Temperature, Density, Specific Gravity; Mole Concept, Equivalent Weight, Composition of solids, Liquids and

Gases, Mass fraction, Mass percent, Mass Ratios, Mole fraction, Mole percent, Volume fraction and Volume percent, Normality, Molarity , Molality

2. **Gases Systems**: Gaseous mixtures, Daltons law, Amagats law, Average molecular weight, Density of gaseous mixture, Estimation of vapour pressure. Humidity and saturation and their applications. Introduction to psychrometry humidity and air-conditioning calculations.
3. **Material Balances without Chemical Reaction:** Material balances; Guidelines for solving material balance problems; Material balance of important industrial operations (Distillation, Absorption and Striping, Extraction and Leaching, Evaporation, Dryer, Mixing, Crystallization etc.); Recycle and Bypass operations.
4. **Material Balances with Chemical Reaction:** Definition of terms involved; Generalized approach for solving problems; Material balance problems involving chemical reaction; Electrochemical reactions; Metallurgical applications; Recycle, bypass and purge calculations.
5. **Energy Balance on Non Reactive Processes**: Elements of energy balance calculations; Change in pressure at constant temperature; Change in temperature; Phase change operations; Mixing and solutions, Thermophysics, Thermochemistry
6. **Energy Balance on Reactive Processes:** Heat of reaction; Measurement and calculation of standard heat of reaction, Hess law; Heat of formation; Heat of combustion; Effect of temperature on heat of reaction; adiabatic reactions
7. **Combustion:** Minimum air required, Excess air, Combustion calculation [6 Hrs
8. **Stoichiometry** and Industrial problems

Reference/Text books:

1. Bhatt B.I. and Vora S.M. "Stoichiometry", Fourth Edition, Tata McGraw-Hill Pub. Co. Ltd.,2004.
2. Himmelblau D.M., "Basic Principles and Calculations in Chemical Engineering", Sixth Edition,Prentice-Hall of India Pvt. Ltd., 2004.
3 Felder R.M. and Rousseau R.W., "Elementary Principles of Chemical Processes", ThirdEdition, John Wiley and Sons, Inc., 2000.
4. V. Venkataramani and N.Anantharaman, Process Calculations. 2003. P.L.Ballaney, "Thermal Engineering".

CH204	**Chemical Engineering Thermodynamics-I : 4-Credit(L-3,T-01, P-0)**

Objectives:

1. The students learn the definitions and relationships among the thermodynamic properties of pure materials, such as internal energy, enthalpy, and entropy.
2. The student learns the terminology of thermodynamics: system, properties, processes, reversibility, equilibrium, phases, and components.

Outcomes:

1. Students should be known basic concepts of thermodynamics.

2. Students must be able to understand the various laws of thermodynamics.

COURSE CONTENT

1. **Introduction and First Law of Thermodynamics**: Scope of Thermodynamics, Thermodynamic Systems: Basic Concepts, Joule's Experiments, Concept of Internal Energy, First Law of Thermodynamics, Energy Balance for Closed Systems, Thermodynamic State and State Functions, Equilibrium, The Phase Rule, The Reversible Process, Constant-V and Constant-P Processes, Enthalpy, Heat Capacity, Mass and Energy balances for Open Systems
2. **Volumetric Properties of Pure Fluids**: General P-V-T Behavior of Pure Substances, Virial Equations of State, The Ideal Gas, Application of the Virial Equations, Cubic Equations of State, Generalized Correlations for Gases, Generalized Correlations for Liquids.
3. **The Second Law of Thermodynamics**: Statements of the Second Law, Heat Engines, Thermodynamic Temperature Scales, Entropy, Entropy Changes of an Ideal Gas, Mathematical.Statement of the Second Law, Entropy Balance for Open Systems, Calculation of Ideal Work, Lost Work, **The Third Law of Thermodynamics**, Entropy from the Microscopic Viewpoint.
4. **Thermodynamic Properties of Fluids**: Thermodynamic Property Relations for Single Phase Systems, Residual Property Relations, Residual Property Calculation by Equations of State, Two-Phase Systems, Thermodynamic Diagrams, Tables of Thermodynamic Properties, Generalized Property Correlations for Gases.
5. **Applications of Thermodynamics to Flow Processes**: Duct Flow of Compressible Fluids, Turbines (Expanders), Compression Processes. Conversion of Heat into Work by Power Cycles: The Steam Power Plant, Internal-Combustion Engines, Jet Engines; Rocket Engines
6. **Refrigeration and Liquefaction**: Carnot Refrigerator, Vapour-Compression Cycle, Choice of Refrigerant, Absorption Refrigeration, Heat Pump, Liquefaction Processes.

Reference/Text books:

1. J.M. Smith and H.C. Van Ness, "Introduction to Chemical Engg. Thermodynamics 6th Edition, International student edition, McGraw Hill publication.
2. B.F. Dodge, "Chemical Engg. Thermodynamics", International student edition McGraw Hill Publication.
3. D.A. Hougen, K.M. Watson and R. A. Ragatz, "Chemical Process Principles", (Vol. II) 2nd Edn. Asia Publishing House.
4. K.V. Narayanan, "Chemical Engg. Thermodynamics", Prentice Hall India
5. Y.V.C. Rao, "Chemical Engineering Thermodynamics, University Press (INDIA) Ltd., Orient Longman Ltd., Hyderabad. Hall India Pvt. Ltd., New Delhi.
6. R. R. Rastogi and R. R. Mishra, "An Introduction to Chemical Thermodynamics", Vikas Publishing House Pvt. Ltd, New Delhi.

UHS221	**Professional Communication :Credit 03 (L-2, T-0, P-2))**

Objectives of the course:

1. *To enable students to speak and write English with a good level of proficiency*
2. *To build confidence in students to face interview, deliver speech, make presentation and participate in meeting and discussion*

To lay a strong foundation on the subject by revising and correcting the basics

Unit-1 Unit 1: Functional Grammar [10]

Building of a sentence and its components, Tense- the time sense: Present, Past and Future tense with uses and applications, Verbs, Noun, Pronoun, Adjective, Adverb, Prepositions and Conjunctions: classification, identifications, uses and applications Active & Passive voice, direct and indirect speech, clause, principles of effective communication.

Unit 2: Listening Skills [3]

Requirements of listening skill, Phonetics and phonology, Articulation of consonants and vowels, Syllables, Weak form stress, Rhythm and intonation, Face to face conversation, Telephonic conversation.

Unit 3: Reading Skills [2]

Requirements of reading skill**,** Reading poetry, Reading prose, Reading article from standard news paper/ magazine

Unit 4: Writing Skill [5]

Paragraph, Resumes, Letters- formal and informal, Circular, Notice, Agendas, Minutes, Reports, E-mail and Blog writing

Unit 5: Speaking Skills [3]

Requirement of speaking skills, Grammatical difficulties, Practice of public speaking, Conversation between /among students or groups on given situations

Unit 6: Integration of skills [5]

Group discussion, Personal interview, Debate and Quiz competition, ppt Presentation,

Practical's and Assignments:

1. Practice of building of sentences and identification of components
2. Practice the uses and applications of tense
3. Identification of parts of speech and form changes- use in sentences
4. Identification of various clauses and their use in sentences
5. **Listening Skills:** Listen few BBC / Voice of America/ NDTV 24*7 or similar standard Television channel / Radio or any standard talk/discussion available in CD/DVD and answer the given questions/ write the summery
6. **Reading Skills:** Read few articles from standard news paper The Hindu/ The Times of India / magazine /books and answer the given questions /write the summery
7. **Writing Skills: (Assignments)**
    a. Write your own CV
    b. Write an E-mail
    c. Write a blog on current topic of discussion
    d. Write a technical report
    e. Write a letter
    f. Comprehension Tests
8. **Speaking and Integration of Skills:**
    a. Converse on few given situations
    b. Group Discussions on a given topic
    c. Debate competition on a given topic
    d. Quiz competition among few groups of students
    e. ppt presentation

Suggested Readings:

1. Essential English Grammar, Raymond Murphy, Cambridge University Press, 1 December, 2007.
2. Oxford English Grammar Course: Advanced, Michael Swan and Catherine Walter, Oxford, 24 February, 2012.
3. Advanced English Grammar, Martin Hewings, Cambridge University Press, 1 December, 2007.
4. *Developing Communication Skills*, **Krishna Mohan** and **Meera Banerjee,** Macmillan India Ltd, New Delhi, 2nd Edition, 2009.
5. Oxford Advanced Learner's Dictionary, 8th Edition

SEMESTER- IV

MA202	**Engineering Mathematics-IV (Complex Analysis) : 4-Credit (L-4,T-0,P-0)**

Course objectives:

- To acquaint student with: the basic concepts of complex variables and the function of complex variables. Motivate students to use critical thinking skill to solve practical problems in Engineering and technology

Course Outcomes: At the end of the course the student is expected to understand:

- Importance of complex variables in finding roots of algebraic equations.
- Complex function can be described Fluid flow and mechanical problems In two dimensional potential theory.
- Properties of the Analytic functions in Engineering field.
- This theory is useful in finding the value of Improper and some real integrals.
- To Design and study images under conformal transformations.

Course Content:

Unit-1

Introduction to Complex Variables.

Unit-2

Function of complex variables, limit , continuity , differentiability , Analytic function & its properties, Cauchy-Riemann equation , Harmonic functions, elementary functions.

Unit-3

Line Integral, Cauchy's theorem & Cauchy's Integral formula & its Applications.

Unit-4

Taylors &Laurent's Series expansions.

Unit-5

Residues, Cauchy's Residue Theorem.

Unit-6

Evaluation of Improper Integrals, Conformal mappings

Text/Reference Books:

- Function Of Complex Variables Dr.A.R.Shastri
- Advanced Engineering Mathematics – R.K Jain& S.R.K Iyenger
- Advanced Engineering Mathematics- Erwin Kreyszig
- Complex Variables & application R.V Churchill ,JW Brown(seventh edition),Mc Graw Hill(2003)

CH206	**Inorganic chemical technology: 4- Credit (L-3, T-0, P-2)**

Objectives:

- To know various unit operations & unit processes in Chemical Engineering.
- To Study process flow diagram for various inorganic products.
- To know different types of manufacturing processes.
- To study properties & applications of inorganic chemicals.

Outcomes.

- Students become familiar with various unit operations and unit processes.
- Understand the process flow diagram for various inorganic products manufacturing processes.

- Understand the properties and application of inorganic chemicals.

COURSE CONTENT

1. **Industrial gases**: CO, CO2, H2, O2, N2, SO2, C2H2, Helium and Nitrogen oxide.
2. **Industrial acids**: 25% & 65% oleums, Liq. Sulphur Trioxide, Liq. Sulphur dioxide manufacture. Sulphuric acid, Nitric acid, Hydrochloric acid and Phosphoric acid.
3. **Miscellaneous Chemicals industries**: Alum [ferric & Non-ferric], sugar, carbon-disulphide
4. **Industrial carbon**: Activated carbon, lamp carbon, carbon black, graphite, industrial diamond, and Inorganic pigments: Study of pigments and dyes.
5. **Marine Chemicals**: Salt from seawater. By-products of salt industry e.g. Bromine and Iodine.
6. **Nuclear Industries**: Nuclear Reactors, Feed materials, Uranium and Nuclear Reactors. Reprocessing of Nuclear materials, protection from radioactivity – measures.
7. **Chloro – alkali industries**: Soda Ash, Bicarbonates, Miscellaneous alkalis, Chlorine, Caustic Soda, Bleaching powder, Hypochlorites and chlorites, Eletrolytic MnO2, Aluminum metal.
8. **Electrolytic and Electrochemical Industries**: Chlorates, Per-chlorates, Primary and Secondary cells. Artificial abrasives, Calcium carbides, Silicides and Nitrides.
9. **Fertilizers**: Ammonia, Nitrogenous fertilizers, Phosphatic fertilizers, Potassic fertilizers, Compound and Complex fertilizers, miscellaneous fertilizers.
10. **Glass-chemistry of glass making and manufacturing process**. Composition of different types of glass special glass lining to vessels. Protective Refractory linings for chemical plants

Reference/Text books:

- Ahluwalia V.K. and Kidwai M, "New Trends in Green Chemistry", Anamaya Publishers, New Delhi.
- Dryden C.E, "Outlines of Chemical Technology", East West Press, 1973
- Kirk – Othmer, "Encyclopedia of Chemical Technology", John-wiley & Science.
- Shreve R.N and Brink J.M, "Chemical Process Industries", McGraw Hill Co.New York, 1977
- Soni P.L. and Kalyal, "Textbook of Inorganic Chemistry", S. Chand & Co.New Delhi.

Lab Work:

1. To determine strength of acid solutions.
2. Standardization of given KOH solution.
3. To determine amount of $KMnO_4$ in given solution.
4. To determine % of iron in given Fe-alloy solution.
5. Dissolve oxygen in a given sample of water
6. Calculate the percentage purity of Na_2CO_3 in provided sample
7. To determine strength in gm/lit of a given $K_2Cr_2O_7$ solution using N/20 $Na_2S_2O_3$
8. Estimation of chlorine contain in given sample of water by Mohrs method

CH207	**Organic Chemical Technology: 4- Credit (L-3, T-0, P-2)**

Objectives:

- To know different reactions & their mechanisms.
- Chemistry or structure, property & uses of various organic substances such as fats,

carbohydrates, starch etc.

- Identification of organic compounds
- Importance of reaction such as halogenations, sulphonation, Nitration, oxidation reaction related to chemical engineering processes.

Outcomes:

- Basic concepts of various organic substances become clean.
- Studied different reactions & their mechanisms.

COURSE CONTENT

1. **Heterocyclic Compounds:** Aromaticity, preparation, Properties and application of Pyrrole, Furan, Thiophene ,Pyridine, Quinoline
2. **Oils and Fats:** Introduction, structure property relationship in fats and oils, physical and chemical properties of oil and fats, analysis of fats and oils.
3. **Soaps and Detergents:** Introduction, Preparation of Soaps, Types of Soaps, cleansing mechanism, limitation of soap as cleansing agent, Detergents
4. **Biomolecules:** (i) Carbohydrate: Cyclic structure of glucose, cellulose, starch cellulose acetate, and cellulose nitrate. (ii) (a)Amino acids: Isoelectric points, Nomenclature, preparation & properties ,(b) Proteins: structure ,classification, properties and color tests.
5. **Nitration:** Nitrating agents, Kinetics and mechanism of aromatic nitration. Thermodynamics of nitrations, Equipments for nitration, Mixed acids for nitration and typical industrial nitration processes e.g., preparation of nitrabenzene, chloronitronapthalene and acetafiline**.**
6. **Sulphonation & *Sulfation*:** Sulphonation and sulfating agents: Kinetics, mechanism and thermodynamics, Industrial equipment and techniques, Technical preparation of sulphonates and sulphates. Sulphation of lauryl alcohol, dimethyl ether etc.
7. **Hydrogenation:** Catalytic Hydrogenation, Kinetics and thermodynamics of hydrogenation, reactions. Apparatus and material of construction, hydrogenations of fatty oils, Synthesis of methanol, Hydroforming of naptha, Hydrogenation of heavy oils
8. **Halogenation:** Thermodynamics and Kinetics of halogen, Pathohalogenation, Equipment and design for halogenations. Technical preparation of halogen compounds e.g. ally1 chloride D.D.T….. B.M.C… Chlorobenzene dichlorodifluro methane, vinyl chloride etc
9. **Oxidation:** Liquid and vapor phase oxidation, kinetics and thermo chemistry, apparatus for oxidation, Technical oxidation of isocurenol, acetaldehyde, Cyclohexane Iso-propylbenzene, napthaleum refinery, electro-plating, tanning, coat mining and radio waste;

Reference/Text books:

- Groggins P.H.: Unit Process in Organic Synthesis, 5th Edition , Tata McGraw Hill.
- DiraiswamyL.k.: Organic Synthesis Engineering, Academic Press, New York.
- Sheenhan W.F.: Principles of Physical Chemistry, Prentice Hall of India Pvt. Ltd. New Delhi
- Dryden C.E., Outline of chemical technology: East West Press.
- P.L. Soni: Organic chemistry, S. Chand Co., New Delhi
- Bhal&Bhal :Organic chemistry, S. Chand Co., New Delhi

Lab Work:

1. Preparation of Asprine (acetyl salicylic acid).
2. Determination of Acid value of oil.
3. Determination of saponification value of given oil.
4. Identification of organic compounds (at list 6).
5. Estimation of glucose in given solution.

6. Preparation of acetanilide from aniline.
7. Purification of organic compounds by crystallization.
8. Preparation of phenol formaldehycle resin.
9. Estimation of Phenol.
10. Qualitative analysis of Monosacehaides and Disacchauider
11. Preparation of Osazane derivative of glucose.

CH208	**Mechanical Operation : 5- Credit (L-4, T-0, P-2)**

Objectives:

Students will learn about

- Fundamentals of solid fluid operation, basic laws of crushing & grinding.
- Calculation of power requirement for the given size reduction.
- Handling of solids, mixing, size reduction and classification of size reduction equipment, size separation, settling etc.

Outcomes:

- Get familiar with the fundamentals, able to calculate power requirement and crushing efficiency for jaw crusher, tumbling mill.
- Able to determine the filtration constants, separation efficiency of classifier.

COURSE CONTENT

1. **Handling of Solids**: Properties of particulate masses: Major distinctive properties, pressures in masses of particles, angle of internal friction, angle of repose. Conveying of bulk solids: Basic idea of conveyor, conveyor selection, screw, belt, vibrating, continuous flow and pneumatic conveyors. Storage and weighing: bulk storage, bin storage, feeders (vibrating hopper, screw feeder, belt feeder), batch and continuous weighing. Packaging: Bags, boxes, drums, packaging operations (weighing, filling and weighing equipment, loading, wrapping, sealing, and labeling)
2. **Mixing and Agitation**:Agitation of low viscosity particle suspensions: axial flow impellers, radial flow impellers, close-clearance stirrer, unbaffled tanks, baffled tanks, basic idea for designing agitators. Types of mixers, various mixers for cohesive solids, power requirements', mixing index, axial mixing. Mixers for free flowing solids: ribbon blenders, screw mixers, tumbling mixers import wheels, mixing index in blending granular solids, mixing index at zero time, rate of mixing.
3. **Size Reduction**: Principles of Commination: Criteria for commination, characteristics of products, Energy and Power requirements Rittinger'sand Kick's Law and work index. Size Reduction Equipment: Crushers, Grinders, and ultrafine grinders cutting machines, equipment operation.
4. **Screening:** Characterization of solid particles: Shape, size, specific sin face, calculation of number of particles in mixture screen analysis.
5. **Filtration**: Classification of filters, various types of cake fitters, principles of cake filtration, clarifying fitters: liquid clarification, Gas cleaning, principles of clarification.
6. **Cross flow Filtration**: Types of membranes permeate flux for ultra filtration concentration polarization, partial rejection of solutes, Microfiltration, selection of filtration Equipment and centrifuges.
7. **Settling: Motion of particles through fluids**: Terminal velocity, hindered setting, stock's law gravity setting processes: Classifiers, clarifies, thickeners, flocculation, rate of sedimentation Design-principles for clarifies and thickener.

8. **Centrifugal Settling processes**: Cyclones, hydro cyclones , decanters, tubular, disk and nozzle discharge centrifugal sludge separators, Centrifugal class fitters, principles of centrifugal sedimentation.

Reference/Text books:

- McCabe, W.L. & Smith, J.C. Unit operations of Chemical Engg. McGrawSmith J.C. Hill
- Foust, A.S Principles of Unit operations, John Willey & Sons.
- Coulson J.M Chemical Engg. Vol, 2, McGraw Hill
- Badger W.L Introduction to Chemical Engg. McGrawHill
- Perry and Chilton Chemical Engg. Hand Book.

Lab Work:

1. To study & find out effect of dry grinding and determine its critical speed and its efficiency.
2. To find the particle size distribution of a mixture of particles by sieve analysis.
3. To study the size reduction of particle by using ball mill.
4. To apply Screen analysis on vibrating screen and calculating screening Analysis.
5. To determine the efficiency of the crusher for crushing a material of known work index (W_i).
6. To study the batch sedimentation process.
7. To study the operation of plate and frame filter press.
8. To study the operation of cyclone separator.

CH209	**Chemical Engineering Thermodynamics-II :3-Credit(L-3, T-0, P-0)**

Objectives:

- The students learn the applications of energy balances in the analysis of batch, flow, and cyclical processes, including power cycles, refrigeration, and chemical reactors.
- The students learn how to obtain or to estimate the thermal and volumetric properties of real fluids.

Outcomes:

- The students must be able to analyze steam power cycles, refrigeration cycles, and liquefaction.
- The Students should be to appreciate that thermodynamics is a science of energy considering its all aspects and transformations.

COURSE CONTENT

1. Heat Effects: Sensible heat effects, Temperature dependency of heat capacity, Latent Heat of pure substance, Standard heats of reaction, formation and combustion, Heat effects of industrial reactions.
2. Solution Thermodynamics: Fundamental property relation, Chemical potential, Partial properties, The ideal gas mixture model, Fugacity and fugacity coefficient, The ideal solution model, Excess properties.
3. Applications of Solution Thermodynamics: Liquid phase properties from VLE data, Activity coefficient, Excess Gibbs Energy, Models for the excess Gibbs energy, Property changes of mixing, Heat effects of mixing process.
4. VLE at low to moderate pressures: The nature of equilibrium, Criteria of equilibrium, The phase rule, Duhem's theorem, Raoult's law, Henry's law, Modified Raoults's law, Dew point and bubble point calculations, Relative volatility, Flash calculations.
5. Thermodynamic properties and VLE from equations of state.
6. Chemical Reaction Equilibria: The reaction coordinate, Equilibrium criteria to chemical reactions, Gibbs free energy change, Equilibrium constant, Effect of temperature on equilibrium constant, Evaluation of equilibrium constants, Relation of equilibrium constant to composition, Equilibrium conversions for single reactions, Phase rule and Duhem's theorem for reacting systems, Multi-reaction equilibria.

Reference/Text books:

1. J.M. Smith and H.C. Van Ness, "Introduction to Chemical Engg. Thermodynamics" 6th Edition, International student edition, McGraw Hill publication.
2. B.F. Dodge, "Chemical Engg. Thermodynamics", International student edition McGraw Hill Publication.
3. D.A. Hougen, K.M. Watson and R.A. Ragatz, "Chemical Process Principles", (Vol. II) 2nd Edn. Asia Publishing House.
4. K.V. Narayanan, "Chemical Engg. Thermodynamics", Prentice Hall India
5. Y.V.C. Rao, "Chemical Engineering Thermodynamics, University Press (INDIA) Ltd., Orient Longman Ltd., Hyderabad. Hall India Pvt. Ltd., New Delhi.
6. R. R. Rastogi and R. R. Mishra, "An Introduction to Chemical Thermodynamics", Vikas Publishing House Pvt. Ltd, New Delhi.
7. D. Shrinivasan, "Chemical Engineering Thermodynamics", New Age International, Publisher New Delhi.
8. G.N. Pandey and J. C. Chaudhari, "Chemical Engineering Thermodynamics", Khanna Publishers, Delhi.

CH210 | Machine Design & Drawing : 3 Credit (L-2,T-0, P-2)

Objectives:

- The student shall gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity.
- Shall be able to choose proper materials to different machine elements depending on their physical and mechanical properties. Thus he shall be able to apply the knowledge of material science in real life usage.
- Student shall gain a thorough understanding of the different types of failure modes and criteria. He will be conversant with various failure theories and be able to judge which criterion is to be applied in which situation.
- Student shall gain design knowledge of the different types of elements used in the

machine design process. Eg. Keys, gears, power screw shafts, couplings etc. and will be able to design these elements for each application.

Outcomes:

- An understanding of Mechanical Engineering design, various design methods, Design synthesis, Considerations in design, Use of standard in design, Selection of preferred sizes, value analysis.

COURSE CONTENT

1. **Introduction:** Mechanical Engineering design, Traditional design, methods, Design synthesis, Aesthetic Considerations in design, Ergonomic considerations in design, Use of standard in design, Selection of preferred sizes, value analysis, Engineering materials, Selection of materials, manufacturing considerations in design, statistical considerations in design
2. **Manufacturing considerations in design:** Tolerances, types of fits, BIS systems of fits and tolerances, selection of fits, tolerances and manufacturing methods, selective assembly , surface roughness, design considerations for cast and forged parts, Modes of failure , F.O.S., Stress due to B.M. , stress due to B.M. stress due to tensional moment.
3. **Power Screws:** Forms of threads, force analysis of square threads and trapezoidal threads, self locking in power screws, collar friction, stresses in screw, Differential and compound screws, Recalculating type ball screws.
4. **Shafts, Keys and Couplings:** Transmission shafting, Design against static load and tensional rigidity, keys: Design of various types of keys, couplings: design of rigidity and flexible couplings.
5. **Gears:** Types of gears, V.R. for each type, selection of types of gear, modes of failure, gear design for maximum power transmitting capacity, Design of spur and helical gear, Lewis equation, Buckingham's Equation, Wear strength of spur & helical gears, gear lubrication
6. **Belt Drives:** Flat and V-belt conformations, geometrical relationships, ration of belt tension, stress in belt, selection of V.belt and flat belts, condition for maximum power transmission
7. **Bearings:** Classification, types, applications, selection and mounting of rolling contact bearing.
8. **Cylinders and Pressure Vessels:** Thin and thick cylinders, principal stresses, Lame's equation, Clavarino's and Birnie's equations, auto frottage, compound cylinders, jacketed joint.

Term work:

1. It shall consist of one imperial size sheet on design of component as above: It shall also consist, of CAD and drafting of gear & belt drive.

Practical /Oral Examination: It shall consist of oral exam based on syllabus prescribed above

Reference/Text books:

- Design of machine element- V.B.Bhandari (Tata McGraw- Hill co.Ltd.)
- Design of Machine Element- M.F.Spotts(Prantice Hall India ltd.)
- Mechanical Engineering Design, - J.E.Shingley (Tata McGraw- Hill co.Ltd.)
- Machine Design – Pandy and shah (Charotar Publisher Co.)
- Machine Design Shaums Series (Tata McGraw- Hill co.Ltd)

UHS222	**Human Values & Professional Ethics** **Credits: 2 ; Teaching hours: 2 + 0 + 0 (2 hrs per week)**

Objectives of the course:

1. Making the students aware and sensitive to value system in real life situations.
2. To help the students to discriminate between ephemeral and eternal values
3. To discriminate between essence and form

Course Outcome:

- The students will be able to recognize importance of human values, harmony and ethical behavior in real life situations

Unit 1: Course Introduction [5]

Need, Basic Guidelines, Content and Process for Value Education

- Understanding the need, basic guidelines, content and process for Value Education.
- A look at basic aspirations: Self Exploration, Happiness and Prosperity
- Fulfillment of human aspirations and harmony

Unit 2: Understanding the Harmony [5]

- Thoughtful human being harmony, sentient, attitude and its importance in relationship
- Significance of restraint and health *(Yama and Niyama)*
- Human goal settings and life management techniques, existence and co-existence, trust, respect in universal order

Unit 3: Understanding professional Ethics [5]

- Harmony at various levels and understanding professional ethics
- Creating environmentally aware engineers
- Humanistic universal education, natural acceptance of human values, ethical human conduct

Unit 4: Competence of professional ethics [5]

- Management models for present technologies, strategies for integrating humans in family and at all levels of existence
- Relevance of the above strategies in becoming responsible engineers, technologists and managers

Unit 5: Motivation [2]

- Contribution of ancestors in science and technology development to raise self esteem in Indian context.

Reference/Text books:

- R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Value Education.
- A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
- Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
- PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
- A.N. Tripathy, 2003, Human Values, New Age International Publishers
- Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi

Tantra Shodh, Amravati.

- Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
- E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
- M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd
- Subroto Bagchi, The Professional
- B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
- B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008. Scheme and Syllabus Bachelor of Computer