

DEPARTMENT OF CHEMICAL ENGINEERING

SECOND YEAR
REVISED SYLLABUS

Semester I&II



SHRI GURU GOBIND SINGHJI INSTITUTE OF
ENGINEERING & TECHNOLOGY,

VISHNUPUNRI, NANDED

2013-14

Semester –III

Sub. Code	CourseTitle	Natureof Subject	Dept. offering the subject	Weekly Load (Hours)			Credit
		Compulsory/ Elective		Lect.	Tut.	Lab.	
MA201	Engineering Math-III	Compulsory	Math	4	--	-	04
CH202	Inorganic Chemical Technology	Compulsory	Chemical	3	--	2	04
CH203	Applied Physical Chemistry	Compulsory	Chemistry	3	--	2	04
CH204	Fluid Flow Operation	Compulsory	Chemical	3	1	2	05
CH205	Material Science & Technology	Compulsory	Chemical	3	--	--	03
HU201	Communication Skills	Compulsory	-	--	-	02	01
Total:				16	01	08	21

Semester-IV

Sub. Code	CourseTitle	Natureof Subject	Dept. offering the sub	Weekly Load (Hours)			Credit
		Compulsory/ Elective		Lect.	Tut.	Lab.	
CH207	Applied Mathematics IV.	Compulsory	Math	4	-	--	04
CH208	Organic Chemical Technology	Compulsory	Chemistry.	3	-	2	04
CH209	Machine Design & Drawing	Compulsory	Chem.	2	--	2	03
CH210	Chemical Process Calculation	Compulsory	Chem.	3	1	-	04
CH211	Solid –Fluid Operation	Compulsory	Chem.	3	1	2	05
CH212	Process Plant Utility	Compulsory	Chem.	3	-	-	03
Total:				18	02	06	23

SEMESTER- V

MA201	Engineering Math-III4-Credit (L-4,T-0,P-0)
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Engineering Math-III Syllabus is common for all branches of Second Year.

CH202	Inorganic Chemical Technology Credit-4 (L-3, T-0, P-2)
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Objective:

1. To know various unit operations & unit processes in Chemical Engineering
2. To Study process flow diagram for various inorganic products
3. To know different types of manufacturing processes
4. To study properties & applications 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. Chlor – alkali industries: Soda Ash, Bicarbonates, Miscellaneous alkalis, Chlorine, Caustic Soda, Bleaching powder, Hypochlorites and chlorites, Electrolytic MnO₂, Aluminium metal.
8. Electrolytic and Electrochemical Industries: Chlorates, Per-chlorates, Primary and Secondary cells. Artificial abrasives, Calcium carbides, Silicides and Nitrides.
9. Fertilisers: 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:

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

CH203	Applied Physical Chemistry:4-Credit(L-3,T-0, P-2)
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Objective:

1. Information of process such as Adsorption, Conductivity and their application.
2. Basic concepts of Physical process become clear.
3. Get idea to determine order of chemical reaction.

Outcomes:

1. Basic concepts of different physical processes become clear.
2. 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, Le Chatelier'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 adsorption, application of adsorption.

4. **Conductometry:** Electrolytic Conductance by solution (Specific, equivalent) factors influencing conductance cell constant, measurement of conductance, conductometric 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 electrochemical 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, equipartitioning of energy Distribution of molecular velocities in three dimensional spaces, types of molecular velocities, Application of kinetic molecular theory.

Reference/Text books:

1. Glasstone S.G.: Physical Chemistry, D. Van Nostrand, New York, New York.
2. Puri B.H. and Sharma L.R.: Principles of Physical Chemistry, S Chand & Co., New Delhi.
3. Sheehan W.F.: Principles of Physical Chemistry, Prentice Hall of India Pvt. Ltd. New Delhi
4. Dryden C.E., Outline of chemical technology: East West Press.
5. Bhal & Tuli: Essentials of Physical chemistry, S Chand & Co., New Delhi.
6. 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 KI.
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 determine the amount of oxalic acid and sulphuric acid in 1 liter of solution given 0.1 N NaOH solution and 0.1 N KMNO₄ solution.
8. To determine the amounts of Na₂CO₃ and NaHCO₃ in the given alkali mixture of solution.
9. Verification of Lambert Beer's Law.

CH204 | Fluid Flow Operation: 5-Credits (L-3,T-1, P-2)

Objective:

Students will learn about

1. Fundamentals of fluid flow, Fluid statics, types of fluids, measuring elements for hydrostatic pressure.
2. Behavior of flowing fluid, Basic equation of fluid flow, flow of compressible and incompressible fluid.

3. Performance of pump and its characteristics.
4. Major and minor energy losses in pipes & pipe fittings.
5. Various valves and their application, measuring devices for flow.

Outcomes:

1. Get familiar with the fundamentals, able to generate velocity profile for the given condition.
2. Calculate the flowrate of flowing stream, pressure drop and losses occurring in pipes.
3. 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, Manometers, Example tube, inclined tube manometers.
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, kinetic energy correction factor, correction for fluid friction, Pump Bernoulli's equation, Eulers equation, 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-poiseuille 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, Flow through annulus, Problems.
5. Flow of Compressible Fluids: Mach number, continuity equation, Total energy Balance, velocity of sound, ideal gas equations, the asterisk condition, stagnation temperature.
6. 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. Venturimeter, orifice meter, pitot tube, rotameters, target meters, vortex-shedding meters, turbine meters, positive displacement meters, magnetic meters: ultrasonic meters. Classification and performance of Pumps, Turbines, Compressors, Blowers, Selection and specification, Net positive Suction Head.
7. Flow past Immersed Bodies: Drag coefficients of typical shapes, form drag and stream lining, Friction in flow through beds of solids, Ergun's equation, Kozeny-Carman equation, Burke Plummer equation, Fluidization, Mechanism of fluidization, particulate and aggregative fluidization, minimum fluidization velocity, expansion of fluidized beds, application of fluidization.

References books

1. McCabe, W.L. Smith, J.C. Unit Operation of Chemical Engg. McGraw Hill
2. Coulson, J.M. Richardson, J.F. Chemical Engg., Vol. 1 Pergamon
3. Foust, A.S. Wensei, L.A., Clump Principles of Unit Operation, John Wiley
4. Baoger, W.L. and Banchemo, J.T. Introduction to Chemical Engg. McGraw Hill
5. Fox, R.W. and McDonald A.T. Introduction to Fluid Mechanics 4th Eds John Wiley and sons 1996.
6. Chattopadhyaya, P. Unit Operations of Chemical Engg.

Labwork:

1. Characteristic curves of centrifugal pumps.
2. Determination of stability of a floating body.
3. Verification of Bernoulli's equation for flow process.
4. Measurement of flow by Ventimeter, Orificemeter etc.
5. Measurement of flow by rotometer, V-notch.
6. Measurement of losses in various fitting and valves.
7. Measurement of losses due to contraction and expansion.
8. Verification of laminar/ turbulent flow regime in a flow process.

CH205 | Material Science & Technology: 3-Credit(L-3,T-0,P-0)**Objective:**

1. To familiar with various solid engineering materials.
2. To study the properties (electrical, mechanical, thermal etc) of different engineering materials.
3. To study the manufacturing process of different engineering materials and the operations involved in it.
4. To understand in which condition which type of engineering material is used.

Outcomes:

1. Students will be able to choose the engineering material according to the service requirement, for designing the equipments.

COURSE CONTENT

1. **Ferrous Metals:** Important varieties of iron ores. Cast iron: types, Mechanical, Thermal and Electrical properties and uses of cast iron. pig iron: Types of pig iron. Wrought iron: Mechanical, Thermal and Electrical properties and uses of wrought iron. Steel: factors affecting physical properties of steel and uses of steel (No manufacturing process).
2. **Non Ferrous Metals:** Aluminum, cobalt, copper, lead, magnesium, nickel, tin and zinc their properties and uses. Mechanical, Thermal and Electrical Properties
3. **Alloys:** Introduction to Phase-Diagrams of metals and its alloys; Fe-Fe₃C; Cu-Ni, Cu-Zn, Al-Cu equilibrium diagrams, methods of improving strength, and applications of metals and alloys. Mechanical, Thermal and Electrical Properties.
4. **Glass:** Definition, classification, composition, types and Thermal and Electrical Properties of glass.
5. **Polymers:** Introduction, Classification, Polymerization, Polymerization techniques, molecular weights of polymers crystallinity in polymers, structural and technological function of polymers, Degradation of polymers, Additives for polymers, Biopolymers Nylon-66, nylon-6, polyesters, polycarbonates, polyurethanes', PVC, polypropylene, rubber.
6. **Phase Deformation:** Single phase metal deformation, failure of metals. Theories of alloying , phase relationship , iron carbon diagram , Nomenclature of steels, utilization of cast iron , mild steel , stainless steel, lead graphite in chemical engineering system.
7. **Composite Materials & Nano Materials :** Classification, Constituents of composites, fibers, glass fibers Carbon fibers, Aramid fibers, Semiconductors ,Super conductors, Surface Modifications using linings of plastics, rubber, glass, ceramics with special reference to the applications in Chemical Industries. Introduction, Classification of nano materials, fullerenes, and inorganic nanoparticles, Application

Reference/Text books:

1. Materials in Industry by W J Patton, Prentice Hall Publication.
2. Introduction to Engineering Materials by Aggrawal, Tata McGraw Hill Publication.
3. Material Science by Narula, Tata McGraw Hill Publication.
4. Elements of Metallurgy by H S Bawa, Tata McGraw Hill Publication.
5. Materials Sci & Engg. By William D.Callister, Jr, An introduction by Willy International.
6. Material Science & Metallurgy by O.P. Khanna, Dhanput Rai Publication.
7. Material Science and Engineering by V.Raghavan, Prentice Hall.

HU201 | Communication Skills: 1-Credit (L-00,T-0,P-02)**Objective:**

1. To impart basic skills of communication in English through intensive practice to the students of Engineering so as to enable them to function confidently and effectively in that language in the professional sphere of their life.

Desired Entry Behavior:

The student must have some basic command of English that is must be able to:

1. Write reasonably grammatically.
2. Understand (if not use) at least some 2500 general purpose words of English
3. Use some 2000 (at least 1500) general purpose words of English to express himself in writing and 1500 such words to talk about day-to-day events and experiences of life.
4. Understand slowly-delivered spoken material in Standard Indian English,
5. Speak reasonably clearly (if not fluently) on routine matters with his fellow students

Teaching Method

1. The topics must be covered essentially through plenty of examples. Lecture classes must be conducted as lecture-cum-tutorial classes. It is a course that aims to develop skills. It is therefore "practical" in orientation. Plenty of exercises of various kinds must be done by the students both inside and outside the class-room.
2. The teacher must not depend on a single or a set of two or three text books. He must choose his materials from diverse sources.
3. Keeping in view the requirements of his students, the teacher may have to prepare some teaching and exercise materials.
4. For practice in listening, good tape recorders can be used if the more advanced facilities (for example, language laboratory) are not available. In fact they can be used very fruitfully.
5. The teacher must function as a creative monitor in the class-room. Minimum time should be spent in teaching phonetic symbols, stress, intonation, etc. The aim should be to enable the student to find out for himself the correct pronunciation of a word from a learner's dictionary. In teaching speaking, emphasis should be on clarity, intelligibility and reasonable fluency rather than no "correct" pronunciation of words. Classroom presentation and group discussion sessions should be used to teach speaking.

I. Some Key Concepts

Communication as sharing; context of communication; the speaker/writer and the listener/reader; medium of communication; barriers to communication; accuracy, brevity, clarity and appropriateness in communication.

II. Writing

Selecting material for expository, descriptive, and argumentative pieces; business letters; formal report; summarizing and abstracting; expressing ideas within a restricted word limit; paragraph division; the introduction and the conclusion; listing reference material; use of charts, graphs and tables; punctuation and spelling; semantics of connectives, modifiers and modal s; variety in sentences and paragraphs.

III. Reading Comprehension

Reading at various speeds (slow, fast, very fast); reading different kinds of texts for different purposes (for example, for relaxation, for information, for discussion at a later stage, etc.); reading between the lines.

IV. Speaking

Achieving desired clarity and fluency; manipulating paralinguistic features of speaking (voice quality, pitch, tone, etc.); pausing for effectiveness while speaking; task oriented, interpersonal, informal and semiformal speaking; making a short, classroom presentation.

V. Group Discussion

Use of persuasive strategies including some rhetorical devices (for emphasizing, for instance; being polite and firm; handling questions and taking in criticism of self; turn-taking strategies and effective intervention; use of body language. Telephonic Conversation

VI. Listening Comprehension

Achieving ability to comprehend material delivered at relatively fast speed; comprehending spoken material in Standard Indian English, British English and American English; intelligent listening in situations such as an interview in which one is a candidate.

Reference/Text books:

1. W.W.S. Bhaskar and N.S. Prabhu, "English Through Reading", Vol.-I & II, MacMillan, 1978.
2. Eunice D'Souza and G. Shahani, "Communication Skills in English", Noble Publishing House.
3. R.C. Sharma and K. Mohan, "Business Correspondence and Report Writing", Tata McGraw
4. Hill, New Delhi, 1994.
5. John Fiske, "Introduction to Communication Studies", Rotledge London, 1990.
6. L. Gartside, "Model Business Letters", Pitman, London, 1992.
7. Longman, "Longman Dictionary of Contemporary English", (or 'Oxford Advanced Learner's
8. Dictionary of Current English', OUP), 1998.
9. Maxwell Nurnberg, and Rosenblum Morris, "All About Words", General Book Depot, New Delhi, 1995.
10. Communication Skill by B.V. Pathak Niraliprakashan

Term Work:

1. Group discussion and summary report, or minutes of meeting.
2. Extempore talk and critical report
3. Interview of outsider personality and report
4. Visit to Industry and report of testing some equipment.
5. News item of industrial accident.
6. Advertisement sketch and production plant report of product.
7. Letter to Industry for employment with biodata.
8. Written report and talk show on awareness for engineers.
9. Comparison of various modes of communication to seniors, juniors and writing a report.
10. Preparation of projector, transparencies for a lecture and presentation for five minutes.
11. Public speaking, practice and criticism report.
12. Notice, Letter, application, Biodata design and report.
13. Mock Interview, critical evaluation and report.
14. General Knowledge test, Aptitude test, Design and Evaluation.
15. Design of talk based on slides, projector sheet, video cassettes, audio cassettes, and computer graphics.
16. Practical of Phonetics with audio cassettes.
17. Vocabulary improvement technique.
18. Design of dress for Officers out look and presentation.
19. Education training on manners at office, college, meetings, seniors, juniors etc.
20. How to write Research Paper.
21. How to write Thesis (Project)
22. How to prepare Proposals.
23. Preparation of LR, Transparencies, Power Point presentation etc.

Practical Examination:

The Practical exam shall consist of exhaustive interview not less than 30 minutes checking confidence, expression, general knowledge, English, technical knowledge, pronunciation, body language, dress, manners.

-----**END of SEMESTER**-----

SEMESTER- IV

CH207 Applied Mathematics IV. (CH207) : 4-Credit (L-4,T-0,P-0)

CH208 Organic Chemical Technology: 4- Credit (L-3, T-0, P-2)

Objective:

1. To know different reactions & their mechanisms.
2. Chemistry or structure, property & uses of various organic substances such as fats, carbohydrates, starch etc.
3. Identification of organic compounds
4. Importance of reaction such as halogenations, sulphonation, Nitration, oxidation reaction related to chemical engineering processes.

Outcomes:

3. Basic concepts of various organic substances become clear.
4. 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 nitrobenzene, chloronitronaphthalene 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 naphtha, Hydrogenation of heavy oils
8. **Halogenation:** Thermodynamics and Kinetics of halogen, Pathohalogenation, Equipment and design for halogenation. Technical preparation of halogen compounds e.g. allyl chloride D.D.T..... B.M.C... Chlorobenedichlorodifluoromethane, vinyl chloride etc
9. **Oxidation:** Liquid and vapour phase oxidation, kinetics and thermochemistry, apparatus for oxidation, Technical oxidation of isocurenol, acetaldehyde, Cyclohexane Iso-propylbenzene, naphthaleum refinery, electro-plating, tanning, coat mining and radio waste;

Reference/Text books:

1. Groggins P.H.: Unit Process in Organic Synthesis, 5th Edition, Tata McGraw Hill.
2. Diraiswamy L.k.: Organic Synthesis Engineering, Academic Press, New York.
3. Sheenhan W.F.: Principles of Physical Chemistry, Prentice Hall of India Pvt. Ltd. New Delhi
4. Dryden C.E., Outline of chemical technology: East West Press.
5. P.L. Soni: Organic chemistry, S. Chand Co., New Delhi
6. 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 formaldehyde resin.
9. Estimation of Pheno.
10. Qualitative analysis of Monosaccharides and Disaccharides
11. Preparation of Osazone derivative of glucose.

CH209 | Machine Design & Drawing (209) : 3 Credit (L-2,T-0, P-2)

Objective:

1. 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.
2. 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.
3. 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.
4. 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:

1. 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 torsional 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 torsional 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, ratio 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, autofrettage, 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:

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

CH210 Chemical Process Calculation: 4-Credit(L-4, T-1,P-0)**Objective:**

1. To understand basic chemical engineering calculations.
2. To know the unit systems , conversions
3. To Perform 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.
3. **Material Balances without Chemical Reaction:** Material balances; Guidelines for solving material balance problems; Material balance of important industrial operations (Distillation, Absorption and Stripping, 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.
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 calculations.
8. Stoichiometry and Industrial problems:
9. Introduction to degree of freedom analysis.

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”, Third Edition, John Wiley and Sons, Inc., 2000.
4. V. Venkataramani and N. Anantharaman, Process Calculations. 2003.
5. P.L. Ballaney, “Thermal Engineering”.

CH211 | Solid –Fluid Operation: 4-Credit(L-3, T-1, P-2)**Objective:**

Students will learn about

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

Outcomes:

1. Get familiar with the fundamentals, able to calculate power requirement and crushing efficiency for jaw crusher, tumbling mill.
2. 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.
3. Mixing of Solids: 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.
4. Size Reduction: Principles of Commination: Criteria for comminution, characteristics of products, Energy and Power requirements Rittinger's and Kick's Law and work index. Size Reduction Equipment: Crushers, Grinders, and ultrafine grinders cutting machines, equipment operation.
5. Screening: Characterization of solid particles: Shape, size, specific surface, calculation of number of particles in mixture screen analysis.
6. Filtration: Classification of filters, various types of cake filters, principles of cake filtration, clarifying filters: liquid clarification, Gas cleaning, principles of clarification.
7. Cross flow Filtration: Types of membranes permeate flux for ultrafiltration concentration polarization, partial rejection of solutes, Microfiltration, selection of filtration Equipment and centrifuges.
8. Settling: Motion of particles through fluids: Terminal velocity, hindered setting, stock's law gravity setting processes: Classifiers, clarifiers, thickeners, flocculation, rate of sedimentation Design-principles for clarifiers and thickener.
9. Centrifugal Settling processes: Cyclones, hydroclones, decanters, tubular, disk and nozzle discharge centrifugal sludge separators, Centrifugal class filters, principles of centrifugal sedimentation.

Text / References:

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

Lab Work:

1. Verification of Stokes Law.
2. Screen analysis of given sample for its particle size distribution.
3. Determination of variation in pressure drop & bed height w.r.t superficial velocity for a bed of solids.

4. Determination of minimum fluidization velocity for a bed of solids.
5. Operating characteristics of crushing and grinding equipments,(Jaw crusher, Roll crusher, Ball mill)
6. Evaluation of the filtration constants for CaCO₃. Slurry in water and cake compressibility.
7. Determination of %age recovery of coal in froth from coal and sand mixture.
8. Determination of thickener capacity using batch sedimentation.
9. Determination of characteristics of centrifuge as a filter.
10. Determination of the separation efficiency of the classifier.

CH212	Process Plant Utility: 3-Credit(L-3,T-0,P-0)
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Objective:

1. To know the various process utilities in chemical industries.
2. To understand the importance of the various process plant utilities to run the plant smoothly.
3. To study the construction and functioning of different plant utilities.
4. To study the steam generation and its distribution.
5. To know the importance of steam economy and also the importance of insulation in any chemical plant.

Outcomes:

1. Students will know the importance of various process utilities and try to maintain in good condition to avoid any breakdown in the process.

COURSE CONTENT

1. **Various process utilities**, their role and importance in chemical plants. Water Sources Sources of water and their characteristics; Treatment storage and distribution of water; 1 Sources of water, hard and soft water , Requisites of industrial water and its uses, Methods of water treatment, Chemical softening, Demineralization SS, Resins used for water softening 8 Reverse osmosis and membrane separation. Effects of impure boiler feed water & its treatments. Scale & sludge formation, Corrosion, Priming & foaming, Caustic embrittlement. Cooling purposes, drinking and process; Reuse and conservation of water; Water resource management.
2. **Steam generation and Utilization:** Steamgeneration and its application in chemical process plants, distribution and utilization :Problems based on enthalpy calculation for wet steam, dry saturated steam, superheated steam, steam economy, Steam condensers and condensate utilization Expansion joints ,flash tank design, steam traps their characteristics, selection and application, waste heat utilization.; Lagging, selection and thickness. Selection and Sizing of Boilers; Types of Boilers, Scaling, trouble shooting, preparing boiler for inspection, Boiler Act.
3. **Compressors, blowers and Vacuum Pumps:** Compressors, blowers and vacuum pumps and their performance characteristics; Methods of developing vacuum and their limitations, material handling under vacuum, Piping systems; Lubrication and oil removal in compressors and pumps. Airfilters, Air and gas leakage. Inert gas systems, compressed air for process, Instrument air.Refrigeration cycles 04, Different methods of refrigeration used in industry. Vapor compression Vapour absorption: Lithium bromide (eco-Friendly). Different refrigerants, Monochlorodifluoro methane (R-22), Chlorofluorocarbons (CFC-Free), Secondary refrigerants: Brines Simple calculation of C.O.P. Refrigerating effects.
4. **Insulation:** Importance of insulation for meeting the process requirement, insulation materials and their effect on various material of equipment piping, fitting and valves etc. insulation for high intermediate, low and sub zero temperatures, including cryogenic insulation.
5. **Psychrometry:** Properties of Air-water vapors. Use of humidity chart, Equipment used for humidification, dehumidification, Evaporative cooling, spray ponds, cooling towers
6. **Non Steam Heating System:** Thermic fluid heater, Down therm heater, Temperature range , Principle and working.
7. **Color codes for various utilities**

Reference/Text books:

1. Nordell, Eskel, "Water Treatment for Industrial and Other Uses", Reinhold Publishing Corporation, New York.
2. Goodall, P. M., "The Efficient Use Of Steam" IPC Science and Technology
3. Lyle O. Efficient Use of Steam, 1963
4. P. L. Balleney" Thermal Engineering" Khanna Publisher New Delhi
5. S.T. Powel "Industrial water treatment" McGraw Hill, Newyork
6. Chattopadhyya" Boiler operations" Tata McGraw Hill, New Delhi
7. P .N .Ananthanarayan Refrigeration & Air conditioning, Tata McGraw Hill.

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