UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

IV SEMESTER

CHEMICAL ENGINEERING

SCHEME -2013

IV SEMESTER
CHEMICAL ENGINEERING (H)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.401	Engineering Mathematics -III (BCHMNPSU)	4	3	1	-	50	3	100	150
13.402	Humanities (ACHPT)	3	3	-	-	50	3	100	150
13.403	Organic Chemistry (H)	4	3	1	-	50	3	100	150
13.404	Electrical Technology (H)	4	3	1	-	50	3	100	150
13.405	Fluid Flow Operations II (H)	4	3	1	-	50	3	100	150
13.406	Chemical Technology II (H)	4	3	1		50	3	100	150
13.407	Chemistry Lab II (H)	3	-	-	3	50	3	100	150
13.408	Software Lab (H)	3	-	-	3	50	3	100	150
	Total	**29**	**18**	**5**	**6**	**400**		**800**	**1200**

13.401 ENGINEERING MATHEMATICS - III (BCHMNPSU)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To introduce the basic notion in complex analysis such as Analytic Functions, Harmonic functions and their applications in fluid mechanics and differentiations and integration of complex functions, transformations and their applications in engineering fields.*
- *Numerical techniques for solving differential equations are also introduced as a part of this course.*

Module – I

Complex Differentiation: Limits, continuity and differentiation of complex functions. Analytic functions – Cauchy Riemann equations in Cartesian form (proof of necessary part only).Properties of analytic functions – harmonic functions. Milne Thomson method.

Conformal mapping: Conformality and properties of the transformations $w = \frac{1}{z}$, $w = z^2$, $w = z + \frac{1}{z}$, $w = \sin z$, $w = e^z$ - Bilinear transformations.

Module – II

Complex Integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – zeros and singularities – residues and residue theorem.

Evaluation of real definite integrals – $\int_0^{2\pi} f(sinx, cosx)dx$, $\int_{-\infty}^{\infty} f(x)dx$ (with no poles on the real axis). (Proof of theorems not required).

Module – III

Numerical techniques-Solutions of algebraic and transcendental equations-Bisection method – Regula-falsi method – Newton - Raphson method. Solution of system of equations - Gauss elimination, Gauss- Siedel iteration. Interpolation – Newton's Forward and backward formulae - Lagrange's interpolation formula.

Module – IV

Numerical integration-Trapezoidal Rule- Simpson's one third rule.

Numerical solution of ODE –Taylor's series method - Euler's method - Modified Euler's method – Runge-Kutta method of order Four.

Numerical Solution of two-dimensional partial differential equation (Laplace equation)-using finite difference method (five point formula)

References:

1. Bali N. P. and M. Goyal, *Engineering Mathematics*, 7/e, Laxmi Publications, India, 2012.
2. Kreyszig E., *Advanced Engineering Mathematics*, 9/e, Wiley India, 2013.
3. Grewal B. S., *Higher Engineering Mathematics*, 13/e, Khanna Publications, 2012.
4. Koneru S. R., *Engineering Mathematics*, 2/e, Universities Press (India) Pvt. Ltd., 2012.
5. Sastry S. S., *Introductory Methods of Numerical Analysis*, 5/e, PHI Learning, 2012.
6. Babu Ram, *Numerical Methods*, 1/e, Pearson Education, 2010.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of this course, the students will be able to use numerical methods to solve problems related to engineering fields. This course helps students to master the basic concepts of complex analysis which they can use later in their career.

13.402 HUMANITIES (ACHPT)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objectives:

- *To explore the way in which economic forces operate in the Indian Economy.*
- *The subject will cover analysis of sectors, dimensions of growth, investment, inflation and the role of government will also be examined.*
- *The principle aim of this subject is to provide students with some basic techniques of economic analysis to understand the economic processes with particular reference to India.*
- *To give basic concepts of book keeping and accounting*

PART I ECONOMICS (2 periods per week)

Module – I

Definition of Economics –Central Economic Problems – Choice of techniques –Production possibility curve – Opportunity Cost-Micro & Macro Economics

Meaning of Demand – Utility-Marginal Utility and Law of Diminishing Marginal Utility-Law of demand - Determinants of Demand – Changes in Demand – Market Demand—Demand, forecasting-Meaning of supply-Law of Supply- Changes in Supply-- Market Price Determination – Implications of Government Price Fixation

Production function – Law of Variable proportion – Returns to scale – Iso-quants and Isocost line- Least cost combination of inputs – Cost concepts – Private cost and Social Cost -

Short run and Long run cost- cost curves – Revenue – Marginal, Average and Total Revenue-Break even Analysis

Module – II

National Income concepts - GNP – GDP – NNP– Per Capita Income – Measurement of National Income-Output method- Income method and Expenditure method -Sectoral Contribution to GDP– Money-Static and Dynamic Functions of Money-Inflation – causes of inflation – measures to control inflation – Demand Pull inflation – cost push inflation – Effects of Inflation – Deflation.

Global Economic Crisis India's Economic crisis in 1991 – New economic policy – Liberalization – Privatization and Globalization-Multinational Corporations and their impacts on the Indian Economy- Foreign Direct Investment (FDI) Performance of India-Issues and Concerns. Industrial sector in India – Role of Industrialization -Industrial Policy Resolutions-Industry wise analysis – Electronics – Chemical – Automobile – Information Technology.

Environment and Development – Basic Issues – Sustainable Development- Environmental Accounting – Growth versus Environment – The Global Environmental Issues- Poverty- Magnitude of Poverty in India- -Poverty and Environment

PART-II- ACCOUNTANCY (1 Period per week)

Module – III

Book-Keeping and Accountancy- Elements of Double Entry- Book –Keeping-rules for journalizing-Ledger accounts-Cash book- Banking transactions- Trial Balance- Method of Balancing accounts-the journal proper(simple problems).

Final accounts: Preparation of trading and profit and loss Account- Balance sheet (with simple problems) - Introduction to accounting packages (Description only).

References

1. Dewett K. K., *Modern Economic Theory,* S Chand and Co. Ltd., New Delhi, 2002.
2. Todaro M., *Economic Development*, Addison Wesley Longman Ltd., 1994.
3. Sharma M. K., *Business Environment in India,* Commonwealth Publishers, 2011.
4. Mithani D. M., *Money, Banking, International Trade and Public Finance*, Himalaya Publishing House, New Delhi, 2012.
5. Dutt R. and K. P. M. Sundaran*, Indian Economy,* S. Chand and Co. Ltd., New Delhi, 2002.
6. Varian H. R., *Intermediate Micro Economics,* W W Norton & Co. Inc., 2011.
7. Koutsoyiannis A., *Modern Micro-economics,* MacMillan, 2003.
8. Batliboi J. R., *Double Entry Book-Keeping,* Standard Accountancy Publ. Ltd., Bombay, 1989.
9. Chandrasekharan Nair K. G., *A Systematic approach to Accounting*, Chand Books, Trivandrum, 2010.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts. Part I and Part II to be answered in separate answer books.

Part I Economics *(70 marks) – Part I shall consist of 2 parts.*

Part A (20 Marks) - Ten short answer questions of 2 marks each, covering entire syllabus of Part I (five questions each from Module I and Module II). All questions are compulsory.

Part B (50 marks) - Candidates have to answer one full question out of the two from Part I (Module I and Module II). Each question carries 25 marks.

Part II Accountancy *(30 marks)*

Candidates have to answer two full questions out of the three from Part II (Module III). Each question carries 15 marks.

Course outcome:

- *The students will be acquainted with its basic concepts, terminology, principles and assumptions of Economics.*
- *It will help students for optimum or best use of resources of the country.*
- *It helps students to use the understanding of Economics of daily life.*
- *The students will get acquainted with the basics of book keeping and accounting.*

13.403 ORGANIC CHEMISTRY (H)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *To impart sound knowledge in the different fields of organic chemistry so as to apply it to the problems in Chemical engineering field.*
- *To develop organic analytical capabilities of students so that they can characterize, transform and use organic materials in engineering and apply knowledge gained in solving related engineering problem.*
- *To evoke interest in students to take up organic chemistry related topics for their project works during their course of study.*

Module – I

Reation mechanism: Electron displacement effects- Inductive effect, Electromeric effect, Mesomeric effect and Hyperconjugation- Homolytic and heterolytic fission- Structure and stability of C^+ and C^- ions.

Attacking reagents: Electrophiles and neucleophiles, Examples- Energy requirements of exothermic and endothermic reactions.

Substitution reactions: Free radical substitution-Nucleophilic substitution, SN_1 and SN_2 mechanism.

Addition reactions: Electrophilic addition: Addition of Br_2 and HBr to alkenes. Nucleophilic addition: Addition of HCN to aldehydes and ketones.

Rearrangements: Mechanism of Beckmann rearrangement and Aldol condensation.

Synthesis and uses of Vanillin, Alizarin, Methyl orange, Glyptal and Polyaramide.

Alkaloids: Isolation from plants-Spath synthesis of nicotine.

Module – II

Benzene and its homologues: Aromaticity- Huckels rule- Aromatic and non aromatic ring structures- Resonance structure of benzene, its stability. Mechanism of nitration, Sulphonation, Friedel Crafts alkylation and acetylation- Orientation in aromatic disubstitution.Directive influence of substituents. Ortho, para and meta directing groups-Anomolous behaviour of halogen substituents.

Aryl amines: Structure and basicity, comparison with alkyl amines-Bromination, nitration and carbylamine reaction of aniline.

Diazonium salts: Preparations and applications.

Phenols: Acidity- Riemer Tiemann reaction and Lederrer Mannase reaction.

Heterocyclic compounds: Pyrrole and pyridine-Structure, synthesis and properties.

Module – III

Cycloalkanes: General methods of preparation- Stability of cycloalkanes, Bayers strain theory, Sacshe Mohr concept.

Aminoacids: Synthesis- Gabriels method, Strecker method and Erlen Meyer azlactone method. Zwitter ion, isoelectric point- Classification and physical charecteristics of aminoacids.

Carbohydrates: Classification and synthesis- Conversions- Aldose to next higher aldose and next lower aldose (Killiani synthesis and Wohl's method). Aldose to ketose and Ketose to aldose- Muta rotation.

Grignard reagents: Synthesis and applications.

Acetoacetic ester: Synthesis and applications.

Module – IV

Fundamentals of Polymer Science and Technology: Macromolecule concepts, structure and architecture, molecular weight trends, Differentiate plastics, thermosets, elastomers, resins, polyelectrolytes, amphiphiles.

Design and Synthesis: homopolymers, copolymers, structure-property relationship- polymer processing – fibers, films, bulk materials,

New macromolecular structures and properties: dendrimers, hyper-branched systems, amphiphilic macromolecules, bottle brushes, polymer brushes, polymersosomes, stimuli-responsive properties and their applications

Terpenes: Isolation, classification and isoprene rule. Citral synthesis and properties.
Soaps and detergents: Cleaning action- Manufacture of detergents- Classification- Water pollution caused by detergents.

References:

1. Bhal B. S. and A. Bhal, *Advanced Organic Chemistry,* S. Chand & Co., New Delhi, 2010.
2. Finar I.L*., Organic Chemistry. Vol.* I & II*,* Longman, 1973.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

- *The confidence level of students will be improved to tackle problems in engineering field related to organic chemistry aspects.*
- *The students gain capability in fabricating novel organic compounds that find various chemical engineering applications.*
- *The students will be equipped to take up organic chemistry related products and topics as part of their project works during higher semesters of the course.*

13.404 ELECTRICAL TECHNOLOGY (H)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

To impart fundamental knowledge of electrical machines and equipment used in Process industries.

Module – I

Transformers - construction - principle of operation - e.m.f. equation - phase diagram on load - equivalent circuit - regulation - losses and efficiency. - OC and SC test - determination of equivalent circuit – autotransformers - instrument transformers.

DC generators - Constructional details-principle of operation - e.m.f. equation-types of generators, performance characteristics and applications-DC motors - production of torque - shunt, series and compound motors - performance characteristics – applications - methods of speed control - starters - universal motor.

Module – II

Three phase induction motors - constructional details-slip ring and cage type - production of torque-slip characteristics and applications. Starters - star delta and rotor resistance types. Losses and efficiency. No load and blocked rotor tests - circle diagram.

Single phase induction motors - types, characteristics and applications.

Module – III

Alternator -Constructional details - frequency-e.m.f. equation - concept of regulation.

Synchronous motors - principle of operation - methods of starting - applications.

Stepper motor - principle of operation and applications.

Module – IV

Electric heating-resistance furnaces and ovens-methods of temperature control. Electric arc furnaces and induction furnace, High frequency heating - Induction and dielectric heating, applications. Electric welding - an overview of different types electric welding.

References:

1. Theraja B. L. and A. K. Theraja, *A Text Book of Electrical Technology*, Vol. II, 23/e, S. Chand and Co., 2006.

2. Chakrabarti A., M. I. Soni and P. V. Gupta, *A Text Book on Power System Engineering*, Dhanapat Rai Publishing Co., 2008.
3. Mehta V. K. and R. Mehta, *Principle of Electrical Engineering and Electronics*, S. Chand and Co., 2006.
4. Gupta J. B., *A Course in Electrical Power*, 15/e, S. K. Kataria and Sons, New Delhi, 2013.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

The students will be equipped to apply the knowledge acquired to solve real time industrial problems related to electrical machines and equipments.

13.405 FLUID FLOW OPERATIONS - II (H)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits:** 4

Course Objectives:

To impart fundamental knowledge about industrial equipments and systems involving flow of fluids both compressible and incompressible, simultaneous flow of fluids with particles, equipment to energize fluids and fluids with solids.

Module – I

Flow past immersed bodies - Drag coefficient - Flow through packed bed - Ergun equation - Kozney-Carman equation - Blake Plummer equation - Design of packed beds - Motion of particles through fluids - Motion from gravitational and centrifugal fields - Terminal settling velocity - Approximate equation - Stoke's law - Intermediate law - Newton's law – Hindered settling Fluidization - The phenomenon of fluidization - Liquid-like behaviour of fluidized beds - Comparison with other contacting methods - Advantages and disadvantages of fluidized beds for industrial applications - fluidization quality. Pressure drop - vacuum - flow rate diagrams, minimum fluidizing velocity, effect of pressure and temperature on fluidized bed behaviour. The expanded bed - Flow patterns in fluidized beds - Design of fluidized beds.

Module – II

Fans and Blowers- classification, power consumption. Compressors –classification, Positive displacement compressors, reciprocating compressors, multi-staging, power consumption, compressor output. Compressible fluids - Mach number - Continuity equation - Total energy balance – Mechanical energy balance - Ideal gas equation - Equations for isentropic flow - Adiabatic frictional flow - Isothermal flow - Measurement of compressible fluid flow.

Module – III

Non-Newtonian fluids - Time dependent flow - Viscosity, rate of shear Vs. shear stress for non- Newtonian fluids - Agitation and mixing of liquids - Agitation equipments - Impellers, propellers, paddles, turbines, flow patterns in agitated vessels, standard turbine design, circulation, velocities and power consumption in agitated vessels - Flow number – velocity gradient and velocity patterns, power correlations, dimensionless groups, blending and mixing, mixer selection, scale-up of agitator design.

Module – IV

Mixing of solids and pastes - Mixers for pastes and plastic masses - change can mixers, kneaders, dispersers and masticators, mixer extruders, mixing rolls, Muller mixers, power requirements, mixing index, mixers for dry powders, mix index in blending granular solids.

Criteria for selection of mixers for solids and pastes. Detailed study of the novel equipments for mixing of solids and pastes.

References:

1. White F. M., Fluid Mechanics, 6/e, Tata McGraw-Hill, New Delhi, 2011.
2. Wilkes J. O., *Fluid Mechanics for Chemical Engineers*, Prentice Hall, 1999.
3. McCabe W. L., J. C. Smith and P. Harriot, *Unit Operations of Chemical Engineering*, 6/e, McGraw-Hill, 2001.
4. Bird R. B., W. L. Stewart and E. N. Lightfoot, *Transport Phenomena,* 2/e, John Wiley, 2007.
5. Denn M. M., *Process Fluid Mechanics*, Prentice Hall, 1980.
6. Darby R., *Chemical Engineering Fluid Mechanics*, Taylor & Francis, 2001.
7. Geankoplis C. J., *Transport Processes and Unit Operations*, Prentice Hall, 2003.
8. Kumar K. L*., Engineering Fluid Mechanics*, Eurasia Publishing House, New Delhi, 2000.
9. De Nevers N., *Fluid Mechanics for Chemical Engineers*, 2/e, McGraw Hill, New York, 1991.
10. Streeter V. L. And E. B. Wylie, *Fluid Mechanics*, McGraw Hill, 1998.
11. Coulson J. M., J. F. Richardson and J. R Backhurst and J. H. Harker, *Chemical Engineering*, Vol. I, Elsevier, 1999.
12. Foust A. S., L. A. Wenzel, C. W. Clump, L. Maus and L. B. Andersen, *Principles of Unit Operation*, 2/e, John Wiley & Sons, 2008.
13. Green D. W. and R. H. Perry, *Perry's Chemical Engineers Handbook*, 8/e, McGraw Hill, 2007.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be three questions each from Module I and Module II, and two questions each from Module III and Module IV.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: Part B questions should have at least 50 % numerical problems. There could be numerical problems in part A also.

Course Outcome:

On doing this course, students will be capable of designing and operating process industry equipments, like packed beds, fluidised beds, settlers and mixers. They will be familiar with the equipments like fans, blowers, compressors, various types of mixers and their selection for a given application.

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13.406 CHEMICAL TECHNOLOGY II

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

To impart knowledge of various process engineering technologies and process flow sheeting methods used in Process industries.

Module – I

Pulp and paper: Manufacture of pulp, mechanical and semi-mechanical and chemical methods - bleaching - paper making, recovery of chemicals from spent liquor, by-products and their uses. *Leather:* leather making, vegetable tanning and chrome tanning – finishing operations - chamois leather.

Sugar: Manufacture from sugar cane and sugar beet, refining of crude sugar, by-products of sugar industry.

Starch: Raw materials, manufacture from corn, maize, tapioca. Manufacture of Dextrin and Dextrose).

Fermentation Products: Manufacture of alcohol, alcoholic beverages and High Fructose Corn Syrup (HFCS).

Module – II

Wood and Wood chemicals: Saccharification of wood, destructive distillation of wood. Composite wood: - plywood, laminated wood, fibre board and particle board.

Perfumes, flavours and cosmetics. Organic surface coatings: Raw materials, formation and manufacture of paints, varnishes, enamels and lacquers.

Pesticides: Classification of Insecticides, Fungicides, Weedicides, Herbicides and Rodenticides. Manufacture of Malathion, Parathion, DDT, BHC, and Endosulfan.

Module – III

Dyes and intermediates: Classification, unit processes and unit operations in the manufacture of dyes, pigments and brighteners.

Drugs and Pharmaceuticals: Classification, raw materials and manufacture of important sulpha drugs, analgesic, antipyretic, antibiotics and anti-inflammatory drugs. Formulations of Tablets, Capsules, Ointments, Liquids and Parenterals. Phytochemicals.

Plastics: Classification, techniques of polymerization, manufacture and uses of phenol formaldehyde, urea formaldehyde, polyethylene, poly vinyl resins, cellulose nitrate and cellulose acetate. Processing of plastics.

Module – IV

Man made fibres: Manufacture of viscose rayon fibre, cellulose acetate fibres, nylons, polyesters, acrylics and modacrylic fibres, vinyl and vinylidines, glass fibres. *Rubber:* Manufacture of natural and synthetic rubbers. Styrene butadiene rubbers (SBR), acrylonitrile butadiene rubber (NER), polymethanes, silicon rubbers, polybutadiene. Compounding, vulcanising and reclaiming of rubber, processing of rubber.

References:-

1. Austin G. T., *Shreve's Chemical Process Industries*, 5/e, McGraw Hill, 1984.
2. Dryden C. E., *Outline of Chemical Technology*, 2/e, Affiliated East- West Press, 1973.
3. International Journal of Chemtech Vol. I – IV
4. Shukla S. D. and G. N. Pandey, *A Text Book of Chemical Technology,* Vikas Publishing House, 1986.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

- *On completion of this course, students will know the process technologies of production of paper, leather, sugar, starch, dextrose, dextrin, alcoholic beverages, wood products, perfumes, paints, other coatings, pesticides, dyes, pharmaceuticals, natural and synthetic rubbers, petrochemicals.*
- *The students will be capable of drawing a flow sheet of the technology of each and use it for project design and implementation.*

14.307 CHEMISTRY LAB - II (H)

Teaching Scheme: 0(L) - 0(T) - 3(P) **Credits**: 3

Course Objective :

- *To impart sound knowledge in the different fields of analytical chemistry and make familiar with the use of modern analytical instruments in lab and industry.*
- *To develop analytical capabilities of students so that they can characterize, transform and use materials in engineering and apply knowledge gained in solving related engineering problems.*
- *To evoke interest in students to take up chemistry related topics in Industrial analysis.*
- *This lab makes them to understand the difference between conventional analysis and modern analysis in different engineering fields.*

List of Experiments:

A. **Volumetric analysis**

1. Preparation of standard solution of sodium carbonate, standardisation of strong acids (Eg. HCl) and estimation of unknown concentration of NaOH.
2. Estimation of carbonate- bicarbonate mixture.
3. Preparation of standard oxalic acid, standardisation of potassium permanganate and estimation of unknown solutions of hydrated ferrous sulphate.
4. Preparation of standard ferrous sulphate solution and standardisation of potassium permanganate and estimation of Mohs salt.
5. Preparation of standard solution of potassium dichromate and estimation of iron.
6. Standardisation of sodium thiosulphate against dichromate and estimation of copper sulphate.
7. Preparation of standard sodium chloride and standardisation of silver nitrate.
8. Estimation of total and permanent hardness by EDTA method.

B. **Analysis of ores and alloys**

9. Estimation of iron in heamatite.
10. Estimation of copper in brass.
11. Estimation of calcium in lime stone or dolamite.

C. **Potentiometric measurements**

12. Estimation of strength of given HCl solution by titrating against sodium hydroxide solution.

13. Determination of electrode potential and emf of an electrochemical cell.

D. **Conductometric measurements**

14. Coductometric titrations

    (i) Strong acid with strong base

    (ii) Strong acid with Weak base

    (ii) Mixture of acid with base

E. **pHmetric measurements**

15. (i) Preparation of buffer and standardisation of pH meter.

    (ii) Determination of molarity of HCl with M/10 NaOH.

F. **Water Analysis**

16. Analysis of Industrial and Domestic water

    (i) Determination of TDS present in a sample of water.

    (ii) Determination of Ca and Mg in a sample of water using flame photometer and UV- Visible spectro photometer.

    (iii) Determination of Sodium and Potassium Using Flame photometer.

    (iv) Determination of Acidity or Alkalinity present in water using P^H meter.

    (v) Analysis of unknown sample of Industrial and domestic water.

References:

1. Thomas A.O., Practical Chemistry, Scientific Book Centre, Cannanore, 2003.
2. Vogel A. I., A Text Book of Quantitative Inorganic Analysis, 4/e, Longman, 1980.
3. Bhasin S. K. and S. Rani, Laboratory Manual on Engineering Chemistry, Dhanpat Rai Publishing Co., 2006.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

University question paper consists of 2 experiments based on the list of experiments prescribed. Marks should be awarded as per the following guidelines.

10% - principle and procedure

70% - Conducting experiment, results, tabulation and inference

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

- *The confidence level of students will be improved to tackle problems in engineering field related to chemical analysis.*
- *The students gain capability in conducting different modern analysis which has various engineering applications.*
- *The students will be equipped to take up chemistry related experiments and analysis, as part of their project works during higher semesters of the course.*

13.408 SOFTWARE LAB (H)

Teaching Scheme: 0(L) - 0(T) - 3(P) **Credits**: 3

Course Objective :

- *During this course the students are expected to get hands on experience in writing computer programs using the MATLAB software as well the C++ programming language.*
- *They will be trained to solve problems in numerical methods for solving engineering problems.*
- *They will be introduced to system simulation using MATLAB.*

Part I : C++ Programming exercises:

Develop programmes to implement numerical methods for the solution of the following:

1. Nonlinear and transcendental equations
2. Linear Algebraic Equations, Set of equations
3. Methods for interpolation and extrapolation
4. Numerical Differentiation and Integration
5. Solution of Ordinary Linear Differential Equations
6. BVP Ordinary and Partial Differential Equations

Part II: Learning and Use of Matlab:

Introduction to MATLAB, Commands and Operators, Handling of Arrays & Matrices.

Programming using m-file scripts and m-file functions, Two-dimensional Plots.

Exercises in MATLAB application to Solution of Engineering problems, Systems Simulation using SIMULINK.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Two Questions of 50 Marks - one each based on the list of exercises prescribed in Part I and Part II.

75% - Performance

25% - Viva voce (Based on Part I and Part II)

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

On completing this course, students will be able to

- *solve engineering problems using computer programs in C++ /MATLAB.*
- *perform simulation studies on engineering systems.*