THIRUVALLUVAR UNIVERSITY

DEPARTMENT OF CHEMISTRY

Certificate and Diploma in Industrial Chemistry

(For UG and PG Chemistry graduates)

ABOUT THE DEPARTMENT

The department of chemistry was established 2002 as post-graduate research department. The full fledged department was started during academic year 2010-11. The department is offering the M.Sc., M.Phil. and Ph.D courses. The department consists of 6 faculty members, 2 administrative staff, 30 research scholars and 52 PG students. The faculty members have been working on the modern and thrust areas in chemistry with financial support from various national funding agencies such as DST, DRDO, BRNS, UGC etc., and continued to publish quality research papers in both national and international journals.

VISION AND MISSION

Statement of Vision

The Department of Chemistry of Thiruvalluvar University is determined to educate and graduate rural students. Also, committed to prepare, compete in and contribute to the needs of modern chemical science based industries and academia. To achieve this vision, the department is dedicated to provide a course of study for post-graduate in chemistry which combines curriculum and research oriented project that are high-quality, innovative and intellectually challenging.

Statement of Mission

The mission of the Department of Chemistry of Thiruvalluvar University is to advance the chemical sciences through the education of post-graduate students in rural society by providing them with quality classroom learning and research opportunities. The department is committed to impart a high standard for excellence in all branches of chemistry by innovative and dedicated teaching at post-graduate level to produce students with good knowledge in chemistry.

The course of study and scheme of examinations

About the Diploma:

Upon completion of this diplamo in Industrial Chemistry, students should be able to understand the basics of many key industries within this subject of Chemistry. Participants of the course will have acquired an overall basic understanding of the basic Chemistry and industrial processes as well as key skills in various analysis techniques and principles. The course is designed to achieve a sound basis to summarize important topics and be reasonably competent to make further progress and educational development in this field with a range of theoretical / experimental skills and insights to assist with any short or long term goals.

Job Potential / Job Opportunities
The following are the job opportunities for diploma holders in Industrial Chemistry.
1. Pharmaceutical Industry
2.Petrochemcial Industry
3.Leather Industry
4.Textile dying Indutry
5.Polymeric Materials Industry
6.Water technology based industries
7.Sugar Industry
8.Food and dairy industry

DURATION OF THE COURSE
The duration of the course shall be for two semesters (one academic year),

ELIGIBILITY FOR ADMISSION: No. Candidate shall be admitted to Diploma in Industrial Chemistry unless he/she had passed B.Sc or M.Sc Chemistry and Mighht have studied in 10+2+3 system or 10+2+5

1.TITLE: Diploma in Industrial Chemistry
2.YEAR OF IMPLIMENTATION: July 2020 onwards
3.COURSE DETAILS:

Total No. of Semesters	– 02 (Two semesters)
Total No. of Papers	– 07
Total No. of Practical course	– 02
No. of practical courses per semester	– 01
Project	– 01 (1 & 2 semsters)
Total no of credits	– 46 (Refer Table-1)

4.PREAMBLE OF THE SYLLABUS:

Diploma in Industrial Chemistry is a post graduation Diploma Course of Thiruvalluvar University. The curriculum is prepared by following the prospectus of various national and international universities. The syllabi are all set to meet the requirement of Chemical Industries in and around Tamilnadu. The students pursuing this course will acquire in-depth understanding of various aspects of chemistry. The understanding of subject, development of experimental skills, designing and implementation of novel synthetic methods, developing the aptitude for academic and professional skills, acquiring basic concepts for structural elucidation with advanced techniques. The project introduced in the curriculum will motivate the students to pursue the research and find a job in reputed chemical industries.

7.FEE STRUCTURE: As per Thiruvalluvar University norms

8.ELGIBILITY FOE ADMISSION

A candidate who has passed the B.Sc., degree examination with Chemistry and Industrial Chemistry as the main subject of study of this university or an examination of any other university accepted by the syndicate as equivalent thereto shall be eligible for admission to the M.Sc., degree in chemistry in the university department.

9. MEDIUM OF INSTRUCTION: English.

10.SCHEME OF EXAMINATION

The semester examination will be conducted at the end of each semester (Both theory & practical examination), for odd semesters in the month of November/December; for even semester in April/May. All theory examination is conducted for three hours irrespective of total marks. However, duration of practical examinations is for 6 hours.

- **Theory paper** will be of 75 marks each for university examination and 25 marks for internal evaluation.

- **Theory question paper**:

Section-A, 10×2	= 20 marks	(50 words; no choice)
Section-B, 5×5	= 25 marks	(200 words; Either Or type)
Section-C, 3×10	= 30 marks	(500 words; 3 out of 5)
Total = 75 marks		

Internal Assessment

Test	: 10 marks (best 2 out of 3)
Assignment	: 05 Marks
Seminar	: 10 Marks
Total	**: 25 marks**

- **Pracitical examination** will be of 75 marks each for university examination and 25 marks for internal evaluation.
  For the **project report**, the maximum mark is 200.

Report	: 150 marks
Viva-voce	: 50 marks

Distribution of marks for project report (Total of 150 marks)

Project will be evaluated by the concerned project guide along with a member nominated by the Head of the Department.
Assessment will be done by the departmental committee every month. Evaluation will be on the basis of monthly progress of project work, progress report, referencing, oral, results and documentation.

Project Guide - 100 marks
(Dissertation Format – 20 marks; Scope of the research problem – 20 marks; Methodology – 20 marks; Analysis – 20 marks, Results and findings-20 marks)

Project examiner - 50 marks
(Dissertation Format – 10 marks; Scope of the research problem – 10 marks; Methodology – 10 marks; Analysis – 10 marks, Results and findings-10 marks)

Viva-Voce examination – 50 marks
(Presentation – 20 marks; subject knowledge – 20 marks; Interaction – 10 marks)

11. Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

12.STANDARD OF PASSING
A candidate should get not less than 50% in the university examination, compulsorily, in all papers, including practicals. Also, the candidate who secures not less than 50% marks in the UE and IA

examinations put together in any theory paper/practical shall be declared to have successfully passed the examination.

- Internal marks will not change. Student cannot repeat internal assessment. If student misses internal assessment examination, s/he will have to score passing minimum in the external examinations only.

Illustration: Theory – Internal Assessment -12 marks and University Examination-38 marks

OR

Internal Assessment-0 marks and University Examinaiton-50 marks.

- There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.
- Internal assessment answer scripts may be shown to the concerned student but not end semester answer script.

Table 1.

Subject	General Title	Credit	Ins. Hrs./ Week	Practical hrs	Seminar/workshop	Exam hrs	Max. Marks		
							IA	Uni. Exam	Total
	Semester-I								
Core-1	Industrial Chemistry - 1	4	4	2	1	3	25	75	100
Core-2	Analytical Techniques in Chemistry (Materials Characterization)	4	4	2	1	3	25	75	100
Core-3	Spectroscopy	4	4	2	1	3	25	75	100
Elective - 1	1A. Composite materials **OR** 1B. Modern Separation Techniques **OR** 1C. Chemistry in day to day Context	3	3			3	25	75	100
Practical-1	Practical Chemistry - I	3	3	3	1	3	25	75	100
Project -1		0			1				
		20	19	9	5	15	125	375	500
	Semester - II								
Core-4	Pharmaceutical Chemistry	4	4		1	3	25	75	100
Core-5	Industrial Chemistry - 2	4	4		1	3	25	75	100
Core-6	Industrial methods and processes (Sugar, textile, leather, polymer industries, dye and pigments)	4	4		1	3	25	75	100
Practical-2	Organic Preparations I &II stage	4	4	4	4	4	25	75	100
Project-1 contd		10	4	0	4	0	50	150	200
		26	20	4	11	13	150	450	600
	Grand Total	46	39	13	16	28	275	825	1100

Semester –I : **Core - 1**

Industrial Chemistry-1

UNIT- I CHEMICAL TECHNOLOGY

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.

UNIT -II INDUSTRIAL GASES AND INORGANIC CHEMICALS

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene. Inorganic Chemicals: Manufacture, application, analysis and hazards inhandling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

UNIT -III INDUSTRIAL METALLURGY

Preparation of metals (ferrous and nonferrous) and ultra pure metals for semiconductor technology.

UNIT -IV FUEL CHEMISTRY

Classification of fuels and their calorific value. Coal: Uses of coal (fuel and non fuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro Gasification and Catalytic gasification), Coal liquefaction and Solvent Refining. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene. Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

UNIT -V OILS AND FATS

Classification of oils, fat splitting, distillation of completely miscible and nonmiscible oils, hydrogenation of oils, rancidity, saponification value, iodine number, acid value, Soap and Synthetic Detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS), detergent binders and builders.

Reference Books

1. J.P. Mukhlyonov: Fundamentals of Chemical Technology.
2. M.G. Rao, M.Sittig: Dryden's out line of Chemicals Technology.
3. G.L. Kehl: Principles of Metallographic Laboratory Practice,

4. Dr. B.K. BhaskaraRao "A Text on Petro Chemicals" 1st Edition, Khanna, Publishers.
5. Bhagan Sahay "Petroleum Exploration and Exploitation Practices" Allied Publishers Ltd., Chennai, 1994.

6. W.L Nelson "Petroleum Refinery Engineering", 4th Edition, McGraw Hill.

7. Principles of Unit Operations by A.S.Foustetal – Wiley International Edition – 1960.
8. Chemical Engineering Vol-1&II by J.M.Coulson and J.F.Richordson – Sixth Edition Butterworth – New Delhi – 2000.

Semester –I Core - 2

Analytical Techniques in Chemistry

UNIT-I SURFACE ANALYTICAL TECHNIQUES-1

Electron Spectroscopy for Chemical Analysis (ESCA): Principles, Instrumentation, and Analytical Applications. Auger electron spectroscopy: Principles, Instrumentation, Applications. Secondary ion mass spectrometry
(SIMS):Principles, Instrumentation, Applications.
Surface enhanced Raman Spectroscopy (SERS): Principles, Instrumentation, Nanoparticulate SERS substrates, Surface enhanced resonance Raman scattering (SERRS), SERRS of Ag and Au metal colloids, Thin solid films, Langmuir-Blodgett Monolayers.

UNIT-II SURFACE ANALYTICAL TECHNIQUES-2

Mapping and imaging, Applications. Electron Energy Loss Spectroscopy (EELS): Principles, Instrumentation, Applications. Electron Microprobe analysis: Principles, Instrumentation, Analysis of semiconductors and crystalline materials, Applications. Low Energy Ion Scattering Spectroscopy: Principle, Instrumentation, Surface structural analysis.

UNIT-III SENSORS

Importance of Sensors, Biomolecular recognition elements, Artificial molecular-recognition materials, Molecular imprinted polymers, Electrode modification. Fluorescence, chemi and bio-luminescence sensors, Fluorescent tag molecules, Applications. **Electrochemical Sensors :**Conductometric sensors, Coulometric sensors, Voltammetric sensors, Applications, Neurotransmitters, Amperometric sensors, Chronoamperometric analysis, Multichannel sensors, Microelectrode sensors, Electrochemical Impedance Sensors, Quartz crystal nanobalance sensors. **Biosensors :** Molecular recognition, Applications. Surface Plasmon resonance based sensors, Fiber optic sensors, Two dimensional microarray based sensors, Applications for Food Safety – Mycotoxins, adultrants, Biomedical diagnosis – Cancer markers.

UNIT -IV

Instrumental methods of analysis: Atomic absorption spectroscopy, chromatography including GC and HPLC and electro-analytical methods (Coulometry, cyclic voltammetry, polarography), Determination of surface area using BET and cyclic voltammetry, Electrochemical impendence spectroscopy.

UNIT -V MATERIALS CHARACTERIZATION

Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), X-ray Diffraction (XRD), Fluorescence Spectrometry, Differential Scanning calorimetry (DSC), Thermogravimetric Analysis (TGA) and Gel permeation chromatography (GPC).

Reference Books

1. Brian R. Eggins, Chemical Sensors and Biosensors, Analytical Techniques in the Sciences (ANTS), 2nd Edition, Wiley, 2002.
2. Gabor Harsanyi, Sensors in Biomedical Applications – Fundamentals, Technology and Applications, CRC Press, 2000.
3. Raluca-Ioana Stefan, Electrochemical Sensors in Bioanalysis, CRC Press,

2001.
4. D J O'Connor, Brett A Sexton, Roger S C Smart (Eds), Surface Analysis Methods in Materials Science, 2nd Edition, Springer, 2010.
5. John C Vikerman, Ian Gilmore (Eds.), Surface Analysis: The Principal Techniques, 2nd Edition, Wiley, 2009.
6. John F Watts, John Wolstenholme, An Introduction to Surface Analysis by XPS and AES, 2nd Edition, Wiley VCH, 2011.

Semester –I Core – 3

Organic Spectroscopy and Synthetic methodology

UNIT-I UV & IR

UV-Visible spectroscopy: Introduction- types of electronic transitions – chromophores and auxochromes – factors influencing positions and intensity of absorption bands, Woodward-Fieser rules for conjugated dienes, carbonyl compounds and enones, ultraviolet spectra of aromatic and heterocyclic compounds.
IR spectroscopy: Introduction- finger print region – Far IR region Applications of IR spectroscopy to identify alkane, alkene, alkyne, aromatic compounds, nitrile and aromatic residues, Identification of alcohols, ethers, phenols, amines and carbonyl compounds such as ketones, aldehydes, esters, amides, acids, conjugated carbonyls compounds and other functional groups- Effect of hydrogen bonding and effect of solvent on vibrational frequencies.

UNIT-II NMR

Introduction-Nuclear spin states- Nuclear Magnetic moments-Absorption of Energy-Resonance-Instrumentation: Continuous wave method, FT NMR- chemical shift and its measurements, factors affecting the chemical shift including anisotropic effect-relaxation processes-spin-spin coupling-coupling constant – multiplicity-spin systems-NOE effects-1H NMR of simple aliphatic and aromatic compounds.
Principles of 13C NMR,- proton decoupled and off – resonance 13C NMR spectra – DEPT methods- factors affecting 13C chemical shift -13C NMR spectra of simple organic molecules.
Problem solving (for molecules with a maximum number of C10).

UNIT-III MASS & PROBLEM SOLVING

Introduction- Principles- Instrumentation-Ionization techniques such as Chemical ionization, Electron ionization, ESI, FD, FAB, MALDI. Applications of mass spectra to elucidate molecular formula and structure. Mc. Lafferty rearrangement-Nitrogen rule-Interpretation of fragmentation pattern of aliphatic alcohols, aldehydes, esters, ethers, hydrocarbons, carboxylic acids, amines, halogen compounds and simple aromatic compounds. Appearance and significance of isotopic peaks.

Structural elucidation of simple organic molecules with the application of spectral techniques-Problems involving combination of spectral data.

UNIT-IV SYNTHETIC METHODOLOGY

An introduction to synthons and synthetic equivalents, functional group interconversions, Planning and execution of multistep synthesis- overall calculation for multistep synthesis- synthesis of simple molecules. The importance of the order of events in organic synthesis, One group C-C disconnections – Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, Olefination of carbonyl compounds, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polaritiy, cyclization reactions, amine synthesis.

UNIT-V CONSTRUCTION OF RING SYSTEMS

Construction of Ring Systems: Different approaches towards the synthesis of three, four, five, and six-membered rings. Pauson-Khand reaction, Bergman cyclization; Nazarov cyclization, inter-conversion of ring systems (contraction and expansion). Construction of macrocyclic rings and ring closing metathesis.

Semester –I : **Practical -1**

PRACTICAL CHEMISTRY

Section A: Inorganic Chemistry - Volumetric Analysis
1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO4.
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.
4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.
5. Estimation of Cu (II) ions iodometrically using Na2S2O3.

Section B: Organic Chemistry
1. Detection of special elements (N, S, Cl, Br, I) in organic compounds (containing upto two special elements)
2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
(a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Section C Practical Industrial Chemistry
1. Determination of alkali in water samples and soaps.
2. Separation of essential oils by soxhlet extractor.
3. Analysis of oils and fats (iodine value, saponification value, acid value).
4. Testing of turmeric powder, milk and mustard oil for adulterants.
5. Estimation of glucose in food samples.
6. Extraction of natural coloring and flavoring agent from flowers and fruits
7. Estimation of hardness of water by titration with soap solution.
8. Estimation of Available Oxygen in Hydrogen Peroxide.
9. Preparation of soap.

Reference Books

1. O. P. Vermani, A. K. Narula: Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi.
2. S. C. Bhatia: Chemical Process Industries, Vol. I & II, CBS Publishers, New Delhi.
3. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
4. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
5. B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut.

Semester 1 **ELECTIVE -1A**

MATERIALS CHEMISTRY

Paper Code: TUCH24C

UNIT-I MATERIAL DESIGN

Materials and their classification, Role of Chemistry in Material design. General methods of synthesis of inorganic materials–homogeneous nucleation and heterogeneous nucleation, growth of nuclei and factors of importance; synthesis of metallic, semiconductor and metal oxide nano particles.

UNIT-II PREPARATIVE TECHNIQUES

Ceramic methods; chemical strategies, chemical vapour deposition-MOCVD; preparation of nanomaterials, Langmuir- Blodgett Films. Fabrication of ordered nanostructures . Composition and purity of materials.

UNIT-III SUPERCONDUCTORS

Structural features of cuprate superconductors. 1-2-3 and 2-1-4 cuprates; structure. Normal state properties: anisotropy and temperature dependence of electrical resistance. Superconducting state: heat capacity, coherence length, relation between Tc and hole concentration in cuprates; mechanism of superconductivity in cuprates. Applications of high Tc-cuprates.

UNIT-IV FUNCTIONAL ORGANIC MATERIALS

Conducting organics - charge transfer materials and conducting polymers. Organic superconductors. Fullerenes. Molecular ferromagnets and ferroelectrics. Liquid crystals: mesomorphic behaviour, optical properties of liquid crystals, display devices.

UNIT-V NLO MATERIALS

Second and third order non-linear effects; molecular rectifiers and frequency doublers; unimolecular electronic devices. Photochromic materials; optical data storage, memory and switches.

Reference Books

1. A.R. West, Solid State Chemistry and its Applications, (1984) John Wiley & Sons, Singapore.
2. C.N R. Rao and J. Gopalkrishnan, New Directions in Solid State Chemistry, (1997) Cambridge Univ. Press.
3. T. V. Ramakrishnan and C.N.R. Rao, Superconductivity Today, (1992) Wiley Eastern Ltd., New Delhi.
4. P. Ball, Designing the Molecular World: Chemistry at the Frontier, (1994) Princeton Univ. Press.

Semester 1 **ELECTIVE -1B**

COMPOSITE MATERIALS

UNIT-I

Atomic structure and bonding, crystal structures lattices, indices etc with examples of atomic structures and bonding types, order and disorder, diffusion mechanisms, deformation mechanisms, classes of metals, point defects, line defects, surface and volume defects, strengthening mechanisms, simple alloys and intermetallics.

UNIT-II

ceramic crystal structures, Atomic defects including intrinsic and extrinsic point defects, Electrical properties including ferroelectrics, thermistors, electrical conductors, dielectrics, Magnetic properties including ferromagnetic and ferromagnetic materials.

UNIT-III

Dielectrics, ferroelectrics and magnetoceramics, Magnetism; Dia-, Para, Ferro-, Antiferro-, Ferri-magnetism, Magnetic properties; Gaint magnetoresistance, Tunneling magnetoresistance, Colossal magnetoresistance, Superparamagnetism High Tc materials: YBCO and Bi-systems (Brief idea), Superconducting nano-materials & their properties and applications. 13

UNIT-IV

Solid state sintering, densification and coarsening processes, grain boundary mobility, porosity evolution (stability/entrapment). Thermal properties including thermal expansion, creep, and thermal stresses. Mechanical properties including strength, toughness, and microstructural design. Composite Interfaces, Bonding Mechanisms, other Interfacial properties

UNIT -V POLYMERS SYNTHESIS AND PROPERTIES

Classification – functionality. Techniques of polymerization: emulsion, bulk, solution and suspension. Mechanism of polymerization : free radical, cationic, anionic and co-ordination polymerization (Ziegler - Natta Catalyst). General characterization - Kinetic chain length – degree of polymerization, Molecular weight calculations (Mn and Mw), Glass transition temperature – Factors affecting Glass transition temperature – crystallinity and melting point. Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Composite Strengths; Fibers as reinforcements.

Reference Books

1. Introduction to Materials Science and Engineering, William J Callister, John Wiley & Sons, Inc.
2. K. Vijayamohanan Pillai and Meera Parthasarathi Functional Materials: A Chemist's Perspective by, Orient Blackswan (21 November 2013)
3. Physical Metallurgy Principles Reed-Hill - R. E., and R. Abbaschian, 3rd ed. Boston: PWS-Kent, 1992.
4. Structure and Properties of Engineering Alloys - Smith, W. F., McGrawHill, 1981.
5. Introduction to Ceramics W.D. Kingery, H.K. Bowen, D.R. Ulhmann.
6. Treatise on Inorganic Chemistry, Vol. II: Subgroups of the periodic table and general topics, Preparation of Metals - H. Remy, Elsevier, 1956.
7. Synthesis of Advanced Ceramic Materials David Segal.
8. Fundamentals of Polymer Science: An Introductory Text - P. Painter and M. Coleman, Technomic, 1997
9. Composite Materials: Engineering and Science - F. L. Matthews and R. D. Rawlings, Chapman & Hall 1994 10.Ceramic Processing and Sintering - M.N. Rahman, Marcel Dekker, Inc.

Semester 1 **ELECTIVE -1C**

CHEMISTRY IN DAY TO DAY CONTEXT

UNIT–I CHEMISTRY IN ENERGY PRODUCTION

Solar energy – fuel from sun light – splitting of water – hydrogen from sunlight – hydrogen economy - fuel cells - batteries - photovoltaics - stealing the sun - nuclear energy - nuclear fission and fusion - production of electricity by a nuclear reactor - radioactivity and the hazards of radioactivity – living with nuclear power.

UNIT–II ENVIRONMENT

The air we breathe - composition of air - burning of hydrocarbons - fog - air quality -ozone - oxygen/ozone screen - biological effect of UV radiation - ozone formation and distribution in the atmosphere - paths of ozone destruction - chloroflurocarbons and their interactions with ozone – the Antartic ozone hole.

UNIT–III CHEMISTRY OF GLOBAL WARMING

Chemistry of global warming - green house effect - earth's energy balance - vibrating molecules and the green house effect – molecular response to radiation – methane and other green house gases – climate modeling.

UNIT–IV AGRICULTURAL CHEMISTRY

Fertilisers - classification - characteristics and uses - pesticides and insecticides - a brief study of additives use and abuse of additives in foods and beverages.

UNIT–V DYES, SOAPS AND DETERGENTS

Dyes - classification based on mode of application and structure - paints - ingredients -drying – pigments – types and properties – varnish. Soaps and detergents - classification - ingredients - solids and liquids - disinfectants (phenyl, dettol type) - perfumes - raw materials - perfumes used in soaps - cosmetics and agarbatti.

Reference books

1. B.K.Sharma, Industrial Chemistry (Including Chemical Engineering), (10 Th Edition),
2. M.Gopala Rao, Outlines of Chemical Technology – For the 21st Century – & Marshall Sittig, 3 rd Edition.
3. Bailey, Clark, Ferris, Isrause, Strong, Chemistry of the environment, 2nd Edn, 2001, Elsevier publications.
4. Energy resources and the environment, V. K. Prabhakar, 2001.
5. Fundamental Concepts of Applied Chemistry, Jayashree Ghosh, S.Chand, 2005

Semester –II

Semester –II Core – 4

Pharmaceutical Chemistry

UNIT-I DRUG DESIGN

Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure-activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism bioisosterism, spatial considerations. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug receptor interactions. PhysicoChemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Free-Wilson analysis, Hansch analysis relationships between Free-Wilson and Hansch analysis.

UNIT-II PHARMACOKINETICS AND PHARMACODYNAMICS

Pharmacokinetics: Introduction to drug absorption, disposition, elimination using pharmacokinetics. Important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process. Pharmacodynamics: Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation. Significance of drug metabolism in medicinal chemistry.

UNIT-III ANTIBIOTICS AND ANTIINFECTIVE DRUGS

Antibiotics: Structure, SAR and biological action of antibiotics. Examples: penicillin: penicillin G, penicillin V, ampicillin, amoxycillin, chloramphenicol, cephalosporin, tetracycline and streptomycin. Sufonanmides: Structure, SAR and mode of action of sulfonamides, sulfonamide inhibition and probable mechanisms of bacterial resistance to sulfonamides. Examples: sulfodiazine, sulfofurazole, acetyl sulfafurazole, Sulfagnanidine, Phthalylsulfo acetamide, Mafenide. Sulphonamide related compounds Dapsone. Local antiinfective drugs: Introduction and general mode of action. Examples: sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, chloroquin and primaquin

UNIT-IV PSYCHOACTIVE DRUGS

Introduction, neurotransmitters, CNS depressants and stimulants. SAR and Mode of actions. Central Nervous System Depressant: General anaesthetics. Sedatives & Hypnotics: Barbiturates and Benzodiazepines. Anticonvulsants: Barbiturates, Oxazolidinediones, Succinimides, Phenacemide and Benzodiazepines. Psycotropic Drugs: The neuroleptics (Phenothiazines and butyrophenones), antidepressants (Monoamine oxidases inhibitors and Tricyclic antidepressants) and anti-anxiety agents (Benzodiazepines). Central Nervous System Stimulants: Strychnine, Purines, Phenylethylamine, analeptics, Indole ethylamine derivatives,

UNIT-V THERAPEUTIC AGENTS AND THEIR MODE OF ACTIONS

Antineoplastic Agents: Cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antiobiotics and mitotic inhibitors. Biological action of mechlorethamine, cyclophosphamide, melphalan, uracil, and 6-mercaptopurine. Cardiovascular Drugs: Antihypertensive and hypotensive drugs, antiarrrhythemic agents, vasopressor drug Direct acting arteriolar dilators. Biological action of methyldopa, propranolol hydrochloride, amyl nitrate, sorbitrate, verapamil, Atenolol. Antihistaminic agents: Ethylene diamine derivatives, amino alkyl ether analogues, cyclic basic chain analogues. Antifertility agents: General antifertility agents. Diuretics: Mercurial diuretic, Non mercurial diuretics (Thiazides, carbonic-anhydrase inhibitors, xanthine derivatives, pyrimidine diuretics and osmotic diureteics

Reference books

1. An Introduction to Medicinal Chemistry, Graham L. Patrick.

2. Medicinal Chemistry: Principles and Practice Edited by F.D. King.
3. Textbook of Organic Medicinal and Pharmaceutical Chemistry, Edited by Charles O. Wilson, Ole Gisvold, Robert F. Doerge.
4. Introduction to Medicinal Chemistry, Alex Gringuage.
5. Principles of Medicinal Chemistry, William O. Foye, Thomas L. Lemice and David A. Williams.
6. Introduction to Drug Design, S.S. Pandeya and J. R. Dimmock, New Age International.
7. Burger's Medicinal Chemistry and Drug Discovery, Vol-1 (Chapter-9 and Ch-14), Ed. M.E. Wolff, John Wiley.
8. Goodman and Gilman's Pharmacological Basis of Therapeutics, Mc Graw-Hill.
9. The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic Press.
10. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley

Semester II Core 5

Industrial Chemistry- 2

UNIT- I INDUSTRIAL ASPECTS OF ORGANIC AND INORGANIC CHEMISTRY

Raw materials for organic compounds: Petroleum, Natural gas, Fractionation of crude oil, cracking, reforming, hydro forming and Isomerisation. Coal: Types of coal, properties, calorific value, distillation of coal, chemicals derived from them. Renewable Natural resources: Cellulose, Starch: - properties, modification, important industrial chemicals derived from them. Alcohols, oxalic acid and Furfural. Physicochemical principles of Extraction of: Iron, Copper, Lead, Silver, Sodium, Aluminium and Zinc.
Inorganic Materials of Industrial Importance: Availability, forms, structure and modifications of – alumina, silicates, clays, mica, carbon, zeolites.

UNIT - II INDUSTRIAL ASPECTS OF PHYSICAL CHEMISTRY AND MATERIAL & ENERGY BALANCES

Surface chemistry and Interfacial phenomena: Adsorption isotherm, Sols, Gels, Emulsions, Micro emulsions, Micelles, Aerosols, Effect of surfactants, Hydrotropes. Catalysis: Introduction, Types, Basic principles, mechanisms, factors affecting the performance, introduction to phase transfer catalysis, industrially important reactions. Dimensions and Units: Basic chemical calculations – atomic weight, molecular weight, equivalent weight, Mole concept, composition of liquid and gaseous mixtures.Material Balance involving chemical reactions: concept of limiting reactant, conversion, yield, selectivity, and liquid phase reaction, gas phase reaction with or without recycle or bypass. Energy Balance: Heat capacity of pure gases and gaseous mixtures at constant pressures, sensible heat changes in liquids, Enthalpy changes.

UNIT III UNIT OPERATIONS, UTILITIES, FLUID FLOW AND HEAT TRANSPORT IN CHEMICAL INDUSTRY

Distillation: Introduction, batch and continuous distillation, separation of azeotropes, plate columns and packed columns. Absorption: Introduction, equipments, packed columns, spray columns, bubble columns, mechanically agitated contactors. Evaporation: Introduction, equipments, short tube evaporator, forced circulation evaporators, falling film evaporators, wiped (agitated) film evaporators. Filtration: Introduction, equipments, plate and frame filter press, Nutch filter, rotary drum filter, sparkler filter, candle filter, Bag filter. Drying: Introduction, free moisture, bound moisture, drying curve, equipments - tray dryer, rotary dryer, flash dryer, fluid bed dryer, drum dryer, spray dryer. Utilities in Industry: Water: Specifications for Industrial use, various water treatments. Steam: Generation and use. Air: Specifications for Industrial use, processing of air. fluid Flow: Fans, Blowers, Compressors, vacuum pumps, Ejectors. Pumps: Reciprocating pumps, Gear pumps, Centrifugal pumps. Heat Transfer: Heat exchangers- shell and tube type, finned tube heat exchangers, plate heat exchangers, refrigeration cycles.

UNIT - IV MATERIAL SCIENCE AND INDUSTRIAL POLLUTION.

Mechanical properties of materials and change with respect to temperature. Metals and alloys: Important metals and Alloys, Iron, Copper, Alluminium, Lead, Nickel, Titanium and their alloys – mechanical and chemical properties and their applications. Cement: Types of cement, composition, manufacturing process, setting of cement. Ceramics: Introduction, types, manufacturing processes, applications, Refractory. Polymeric Materials: Industrial polymers and composite materials – their constitutions, chemical and physical properties, Industrial applications. Glass: Types, composition, manufacture, physical and chemical properties, applications. Corrosion: various types of corrosion relevant to chemical industry - mechanism, preventive methods. Industrial pollution: Pollutants and their statutory limits, pollution evaluation methods. Air pollution – various pollutants Water pollution – organic/inorganic pollutants Noise pollution. Pesticide pollution Radiation pollution and Green House Effect.

UNIT -V UNIT PROCESSES IN ORGANIC CHEMICALS MANUFACTURE.

Nitration: Introduction, nitration of paraffin hydrocarbons - benzene to nitrobenzene, Acetanilide to p-nitro acetanilide, continuous Vs batch nitration. Halogenation: Introduction, reagents for halogenations, halogenations of aromatics – side chain and nuclear halogenations, commercial manufacture of chlorobenzene, Sulphonation: Introduction, sulphonating agents, chemical and physical factors in sulphonation, mechanism of sulphonation, commercial sulphonation of benzene, Hydrogenation: Introduction, catalysts for hydrogenation reactions, hydrogenation of vegetable oil, manufacture of methanol from carbon monoxide and hydrogen, catalytic reforming. Alkylation: Introduction, alkylating agents, mechanism of alkylation reactions, manufacture of phenyl ethyl alcohol and ethyl benzene. Esterificatioon: Introduction, esterification by organic acids, by addition of unsaturated compounds, esterification of carboxy acid derivatives, commercial manufacture of ethyl acetate. Commercial manufacture of aniline, m-nitroaniline, p-aminophenol. Aminolysis: Introduction, aminating agents, factors affecting. Hydrolysis: Introduction, hydrolyzing agents, mechanism of hydrolysis.

Semester II Core 6

Industrial Processes and Methods

UNIT -I SUGAR INDUSTRY

Introduction, history of sugar industry, Soruces for manufacturing sugar, Sugar production from sugar cane. **Industrial methods and processes:**Refining of raw cane sugar. New and other uses of sugar.

UNIT - II PETROCHEMICAL INDUSTRY-1

ntroduction, Occurrence of Petroleum by Biological method - Composition of Petroleum, Properties of - Paraffin's, Olefins, Naphthalene, Aromatics and Inorganic impurities -sulphur, nitrogen, chlorine- Source and reservoir rocks-Oil bearing rocksContinental environment-Transitional environment-Marine environment- Refineries & its capacity in India.

UNIT -III PETROCHEMICAL INDUSTRY-2

Dehydration and Desalting of crude by settling and electric Desalting method Two-state Distillation unit with stabilizer - Blending– Batch Blending, Line Blending, Gasoline Blending, Fuel oil Blending - Impurities, Mechanical Impurities, Chemical Impurities - Overhead Corrosion in Distillation unit. - Concept of flow diagram, Systematic representation and symbols used in relevant process equipment, Unit Operations, Unit Process, P & I diagram, Process Intensification - Flow diagram and Process description of Amine Treatment for LPG, Merox Treatment Process. Flow diagram and Process description of: Hydrodesulphurization Process, Hydro fining Process - Phenol Extraction of Lubes, Furfural Extraction of lubes – Catalytic Reforming- Flow diagram and Process description of: Vis breaking, Dubs Two coil Cracking Process- Fluid Catalytic Cracking, Hydro cracking- Coking definition, Delayed coking operation, Decoking.

UNIT - IV LEATHER INDUSTRY-1

Introudction. Processes: 1. Curing:- Definition; necessity; principles and different state of cured hides and skins. 2. Soaking:- Physico-Chemical explanation of wetting; objectives and different controls in soaking operation . 3. Liming:- Chemistry of unhairing; unhairing by different methods; objectives of liming; effects of liming on collagen; controls in liming operation to achieve different physical properties of leather. 4. Deliming and Drenching:- Objectives, principles and controls of deliming and drenching. 5. Bating:- Chemistry of Proteolytic enzymes used for bating; necessity of bating ; its preparation and controls for desired properties of leather. 6. Pickling:- Acid binding capacity of collagen; use of organic acids or salts in pickling; its necessity and controls; concept of Depickling. 7. Degreasing:- Objectives and necessity of Degreasing; different degreasing systems and methods.

UNIT - V LEATHER INDUSTRY-2

Tanning Operations : Tanning materials – Vegetable, mineral and organic - their classification – chemistry & Technology of tanning materials & methods – characterization manufacture & analysis of various tanning materials. Theory & mechanism of vegetable, chrome, Aluminium, Zirconium, Iron, Titarium, Aldehyde, Oil and other organic tanning. Various unit operations involved in tanning processes their objectives & principles – cleaner processing options – Analysis & characterization of various types of leathers - Physical and chemical testing - Standards and quality control measures in tanning operations.

Reference books

1. Hand of book of cane sugar by Meade & Chen
2 Introduction to cane sugar technology by Jenkins G.H.
3 Unit operation in cane sugar production by John H.Payne
4. Chemistry in Engineering and Technology, Vol.2, TMH Publishing Co Ltd., New Delhi, 1994
5. BienkiewiCz, Physical Chemistry of Leather Manufacture, Krieger, Florida, 1982.
6. Austin, G.T., Shreve's "Chemical Process Industries", 5th ed., McGraw-Hill, 1998.
7. Srikumar Koyikkal,"Chemical Process Technology and Simulation",PHI Learning Ltd (2013).

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