UNIVERSITY OF MADRAS

B.Sc. DEGREE COURSE IN CHEMISTRY

SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC03

CORE-III: MAJOR PRACTICALS - I

(90 HOURS: I & II SEMESTERS 3 CREDITS)

[The procedure for the practical examination will be given by the examiner]
The following volumetric analyses are prescribed.

1. Estimation of HCl by NaOH using a standard oxalic acidsolution
2. Estimation of $Na_2CO_3$by HCl using a standard Na_2CO_3solution
3. Estimation of oxalic acid by $KMnO_4$ using a standard oxalicacid.
4. Estimation of Ferrous sulphate by $KMnO_4$ using a standard Mohr's saltsolution.
5. Estimation of $KMnO_4$ by sodium thiosulphate using a standard $K_2Cr_2O_7$solution
6. Estimation of iron by $K_2Cr_2O_7$ solution using a standard Ferrous sulphate solution
7. Estimation of Copper sulphate using a standard$K_2Cr_2O_7$solution.
8. Estimation of Mg(II) by EDTA solution using standard Zinc sulphate solution.
9. Estimation of Zn(II) by EDTA solution using standard Magnesium sulphate solution.
10. Estimation of total hardness of water.

The following inorganic preparations are prescribed

1. Preparation of Ferrous ammonium sulphate or Mohr'ssalt
2. Preparation of potash alum or potassium aluminium sulphate
3. Preparation of microcosmic salt
4. Preparation of tetrammine copper(II) sulphate

Learning outcomes

1. To understand about the origin and physical properties of Soil.
2. To understand the chemical properties of soil and methods of analysing.
3 To learn about the different types of plant nutrients and their importance.
4. To learn about the fertilizers and their uses.
5. To understand about the classification of various pesticides, fungicides and herbicides.

UNIVERSITY OF MADRAS

B.Sc. DEGREE COURSE IN CHEMISTRY

SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC01

CORE-I: GENERAL CHEMISTRY-I

Learning outcomes

1. To know the fundamental concepts of atomic structure and basics of quantum mechanics.
2. To know the periodicity of properties of elements.
3. To understand the various types of chemical bonding and basics of solid state.
4. To learn the principles of inorganic qualitative and quantitative analysis. To understand the basic concepts of nanotechnology
5. To understand the basic concepts of organic chemistry.

Semester	Subject	Hours	Credits
I	General Chemistry –I	75	4

Unit - I Atomic Structure and Introduction to Quantum Mechanics (15 hrs)

Rutherford's atomic model, Planck's quantum theory of radiation, Photoelectric effect, Bohr's theory of hydrogen atom - postulates, Bohr's radius, energy of electron, origin of hydrogen spectrum. Particle and wave nature of electron - de Broglie's equation, Heisenberg's uncertainty principle and Compton effect - Schrodinger wave equation (no derivation) - Significance of Ψ and Ψ^2- Wave mechanical concept of atomic orbitals, - Shapes of orbitals - Quantum numbers - Zeeman effect, Pauli`s exclusion principle, Aufbau principle - Effective nuclear charge, screening effect, Slater's rules -applications and limitations. Electronic configuration of first 30 elements - extra stability of half-filled and completely filled orbitals. Hund's rule - its basis andapplications.

Unit - II Classification of Elements and Periodicity of Properties (10 hrs)

Classification of elements - noble gases and s, p, d and f - block elements. Modern periodic table. Position of hydrogen in the periodic table-Variation of atomic volume, atomic and ionic radii, ionization potential, electron affinity, electronegativity along periods and groups-variation of metallic characters-factors influencing the above periodicproperties.

Unit - III

3.1 Chemical Bonding (15hrs)

Ionic bond - factors influencing the formation of ionic compounds - ionisation energy, electron affinity and lattice energy; inert pair effect, Fajan's rules.

Covalent bond - polarity of covalent bond, percentage ionic character of covalent bond, dipole moment and molecular structures of CO_2, H_2O, NH_3 and CH_4 , bond characteristics - bond length, bond angle and bond energy.

3.2 Solid State

Classification of solids, isotropic and anisotropic crystals, representation of planes, Miller indices, space lattice, unit cell, crystal systems. X-ray diffraction-derivation of Bragg's equation, discussion of structures of NaCl, CsCl and ZnS, determination of Avogadro's number.

Unit - IV Principles of Inorganic Qualitative and Quantitative Analysis (10 hrs)
Common ion effect, solubility product, applications of the solubility product principle in qualitative analysis. Principle of elimination of interfering anions. Complexation reactions in qualitative analysis. Spot test reagents and tests with them - Cupferon, DMG, thiourea, magneson, alizarin and Nessler reagent. Volumetric analysis - Definitions - normality, molarity, molality and molefraction,

primary and secondary standards, theories of acid - base, redox, complexometric, iodometric and iodimetric titrations, calculations of equivalent weights, theories of acid - base, redox, metal ion and adsorption indicators and choice of indicators.

Nanotechnology(10Hrs)
Introduction to nano science and nanotechnology – Types of nanoparticles, Techniques to synthesize nanoparticles, Physical methods – Physical vapour deposition (evaporation and sputtering) – chemical methods–reduction methods – sol–gel methods

Unit - V Basic Concepts of Organic Chemistry (15 hrs)

Hybridisation and shapes of molecules - methane, ethane, ethylene, acetylene and benzene. Electron displacement effects - inductive, electromeric, mesomeric (resonance) and hyperconjugation. Steric effect. Cleavage of bonds - homolytic and heterolytic fissions. Reactive intermediates - carbocations, carbanions and free radicals - their formation and stability.
Nomenclature of organic compounds: IUPAC system of nomenclature of compounds containing upto 8 carbon atoms - mono and bifunctional compounds.

Textbooks :

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th ed., New Delhi, Vishal Publishing Co.,2016.
2. Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 33th ed., New Delhi, Milestone Publishers and Distributors,2016.
3. Soni P.L., and Chawla H.M., Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons, 2007.
4. T. Pradeep, Nano: The Essentials, New Delhi, McGraw Hill,2007
5. H.M., Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons,2007.
6. Fundamentals of Crystal Chemistry, T R N Kutty;J A K Tareen, Universities Press Private Limited, Chennai, 2000
7. Basic Course in Crystallography, A, J A K Tareen;T RN Kutty, Universities Press Private Limited, Chennai, 2000

Reference Books

1. Jain M.K, Sharma S.C. Modern Organic Chemistry, Vishal Publishing Co.,2017
2. Lee J.D. Concise Inorganic Chemistry, 5th ed., Blackwell Science,2005.
3. Soni, P.L. and Mohan Katyal. Textbook of Inorganic Chemistry, 20th ed., Sultan Chand & Sons, 2006.
4. Glasstone Samuel. Textbook of Physical Chemistry, 2nd ed., Macmillan India Ltd.,1990.
5. Soni P.L., Dharmarha O.P. and Dash U.N Textbook of Physical Chemistry, 23rd ed., New Delhi, Sultan Chand & Sons,2011.
6. Graham Solomons T.W. Organic Chemistry, 3rd ed., John Wiley &Sons.
7. Morrison R.T. and Boyd R.N., Organic Chemistry, 6th ed., Pearson Education, Asia,2002.
8. C. N. R. Rao, Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley-VCH Verlag GmbH & Co. KgaA,2004
9. Charles P. Poole Jr., Frank J. Owens, Introduction to Nanotechnology, New Jersey, John Wiley & Sons, 2003

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC02

CORE-II: GENERAL CHEMISTRY – II

Units Learning outcomes

1. To equip the learners with concepts of s block elements through comparative study.
2. To equip the learners with concepts of p block elements through comparative study.
3. To understand the aspects of gaseous state.
4. To understand the aspects of liquid state, colloids and carbon nanotubes, fullerenes
5. To understand the chemistry of organic compounds like alkanes, cycloalkanes, alkenes, alkynes and the conformational analysis.

Semester	Subject	Hours	Credits
II	General Chemistry - II	75	4

UNIT-I Chemistry of s- Block Elements [Group IA and IIA] (10 hrs)

Hydrogen: Position of hydrogen in the periodic table.
Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li with Mg. Extraction of Li from its silicate- ores. Preparation, properties and uses of NaOH,Na_2CO_3, KBr $KClO_3$ alkaline earth metals: Comparative study of the elements with respect to oxides, hydroxides, sulphates, halides and carbonates. Extraction and anomalous behaviour of Be.

UNIT-II Chemistry ofp- Block Elements (10 hrs)

2.1 Boron Family[Group-IIIA]: preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and its uses. Alloys of Al. 2.2 Carbon Family (Group -IV A) : comparison of carbon with silicon. Carbon-di-sulphide – Preparation , properties , structure and uses. Percarbonates , per monocarbonates and per dicarbonates. Tin- Allotropic forms of Tin, alloys of tin, tinning, tin plating. Lead-lead accumulator (discharging and recharging), leadpigments.

UNIT-III Gaseous State (15 hrs)

Postulates of kinetic theory of gases, derivation of gas laws from the kinetic gas equation.Kinetic energy and temperature-average translational kinetic energy and its calculation. Maxwell's distribution of molecular velocities(no derivation)-mean, root mean square and most probable velocity. Collision diameter, collision number, collision frequency, mean free path. Principle of equipartition of energy. Real gases- van der Waals equation of state-derivation. Boyle temperature.Significance of critical constants.

UNIT-IV

4.1 Liquid State (20 hrs)

Some Properties of Liquids(molecular basis)-Equilibrium vapour pressure of a liquid, boiling point, heat of evaporation, heat of condensation, freezing point. Surface tension-definition, measurement of surface tension, effect of temperature on surface

tension.Parachor-definition, calculation and applications.
Viscosity or fluidity-definition, measurement and calculation, factors affecting viscosity.

4.2 Nanoparticles of Au, Ag and TiO_2 –preparation, properties and uses. Carbon nanotubes-Types- preparation, properties and uses-Fullernene – Introduction only

UNIT-V (20 hrs)

5.1 Chemistry of Alkanes and Cycloalkanes : General methods of preparation and properties of alkanes and cycloalkanes ,Conformational analysis of ethane and n-butane. Baeyer's straintheory.

5.2 Alkenes, Alkynes and Dienes: Preparation of alkenes (dehydrogenation, dehydrohalogenation and dehydration), preparation of alkynes(dehydrohalogenation, dehalogenation).Addition (with mechanisms) of H_2, X_2, HX, HOX, B_2H_6 and O_3 to alkenes and alkynes. Addition of HBr (peroxide effect; free radical reaction mechanism) to alkenes and alkynes. . Allylic substitution of alkenes by NBS. Dienes types, stability; preparation of- 1,3-butadiene,isoprene, and chloroprene. Reactivity: 1,2- and 1,4-additions to butadiene. Diels-Alder reaction.

Textbooks :

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th ed., New Delhi, Vishal Publishing Co.,2016.
2. Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 33th ed., New Delhi, Milestone Publishers and Distributors,2016.
3. Soni P.L., and Chawla H.M., Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons, 2007.
4. Understanding Chemistry, C N R Rao, Universities Press Private Limited, Chennai,1999
5. The Chemistry of the p-Block Elements: Syntheses, Reactions and Applications, Anil J Elias, Universities Press Private Limited, Chennai,2019
6. T. Pradeep, Nano: The Essentials, New Delhi, McGraw Hill,2007

Reference Books

1. Lee J.D. Concise Inorganic Chemistry, 5th ed., Blackwell Science,2005.
2. Jain M.K, Sharma S.C. Modern Organic Chemistry, Vishal Publishing Co.,2017
3. Soni, P.L. and Mohan Katyal. Textbook of Inorganic Chemistry, 20th ed., Sultan Chand & Sons, 2006.
4. Glasstone Samuel. Textbook of Physical Chemistry, 2nd ed., Macmillan India Ltd.,1990.
5. Soni P.L., Dharmarha O.P. and Dash U.N Textbook of Physical Chemistry, 23rd ed., New Delhi, Sultan Chand & Sons,2011.
6. Graham Solomons T.W. Organic Chemistry, 3rd ed., John Wiley&Sons.
7. Morrison R T and Boyd R N, Organic Chemistry, 6th ed., Pearson Education, Asia,2002.
8. C. N. R. Rao, Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley-VCH Verlag GmbH & Co. KgaA,2004
9. Charles P. Poole Jr., Frank J. Owens, Introduction to Nanotechnology, New Jersey, John Wiley & Sons, 2003

UNIVERSITY OF MADRAS
U.G. DEGREE COURSE

ENVIRONMENTAL STUDIES PROGRAMME
ABILITY ENHANCEMENT COMPULSORYCOURSES
(AECC- Environmental Studies)
Syllabus with effect from the academic year 2018-2019
(i.e. for batch of candidates admitted to the course from the academic year 2017-18)

Credits: 2 II Year / III/IV Sem.

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; concept of sustainability and sustainable development.

Unit 2 : Ecosystem (2 lectures)

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem:
  Food chains, food webs and ecological succession, Case studies of the following ecosystem:
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystem (ponds, stream, lakes, rivers, ocean, estuaries)

Unit 3: Natural Resources : Renewable and Non – renewable Resources (6 lectures)

- Land resources and landuse change: Land degradation, soil erosion and desertification.
- Deforestation : Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over –exploitation of surface and ground water, floods, droughts, conflicts over water (international and inter-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4: Biodiversity and Conservation (8 lecturers)

- Levels of biological diversity: genetics, species and ecosystem diversity, Biogeographic zones of India: Biodiversity patterns and global biodiversity hot spots
- India as a mega- biodiversity nation, Endangered and endemic species of India.
- Threats to biodiversity: Habitat loss, poaching of wildlife, man- wildlife conflicts, biological invasions; Conservations of biodiversity: In-situ and Ex-situ Conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 5: Environmental Pollution (8 lecturers)

- Environmental pollution: types, causes, effects and controls: Air, Water, soil and noise Pollution.
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies.

Unit 6: Environmental Policies & Practices (8 lecturers)

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act, Air (Prevention & Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human Wildlife conflicts in Indian context.

Unit 7: Human Communities and the Environment (7 lectures)

- Human population growth, impacts on environment, human health and welfare.
- Resettlement and rehabilitation of projects affected persons; case studies.
- Disaster management: floods, earthquake, cyclone and landslides.
- Environmental movements : Chipko, Silent Valley, Bishnois of Rajasthan.
- Environmental ethics : Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies(e.g. CNG Vehicles in Delhi)

Unit 8 : Field Work (6 lectures)

- Visit to an area to document environmental assets: river / forest/ flora/ fauna etc.
- Visit to a local polluted site – Urban / Rural/ Industrial/ Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystem- pond, river, Delhi Ridge etc.

(Equal to 5 Lectures)

Suggested Readings:

1. Carson , R. 2002.Slient Spring, Houghton Mifflin Harcourt.
2. Gadgil , M.,& Guha, R. 1993.This Fissured Land: An Ecological History of India. Univ.of California Press.
3. Glesson, B. and Low, N.(eds.)1999. Global Ethics and Environment, London, Routledge.
4. Gleick,P.H.1993.Water Crisis. Pacific Institute for Studies in Dev.,Environment & Security. Stockholm Env.Institute, Oxford Univ.Press.
5. Groom, Martha J., Gary K.Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates,2006.
6. Grumbine,R.Edward, and Pandit,M.K2013.Threats from India's Himalayas dams .Science,339:36-37
7. McCully,P.1996.Rivers no more :the environmental effects of dams(pp.29-64).Zed books.
8. McNeill,John R.2000.Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum,E.P.,Odum, H.T.& Andrees,J.1971.Fundamental of Ecology. Philadelphia Saunders.
10. Pepper,I.L.,Gerba,C.P & Brusseau,M.L.2011.Environmental and Pollution Science. Academic Press.
11. Rao,M.N.& Datta,A.K1987.Waste Water Treatment. Oxford and IBH Publishing Co.Pvt.Ltd.
12. Raven,P.H.,Hassenzahl,D.M & Berg,L.R.2012 Environment.8th edition. John Willey & sons.

13. Rosencranz, A., Divan,S.,& Noble, M.L.2001.Environmental law and policy in India. Tirupathi 1992.
14. Sengupta,R.2003.Ecology and Economics: An approach to sustainable development.OUP
15. Singh,J.S.,Singh,S.P and Gupta,S.R.2014.Ecology,Environmental Science and Conservation. S.Chand Publishing, New Delhi.
16. Sodhi,N.S.,Gibson,L.&Raven ,P.H(eds).2013.Conservation Biology :Voices from the Tropics. John Willey & Sons.
17. Thapar,V.1998.Land of the Tiger: A Natural History of the Indian Subcontinent.
18. Warren,C.E.1971.Biology and water Pollution Control. WB Saunders.
19. Willson,E.O.2006. The Creation: An appeal to save life on earth..New York: Norton.
20. World Commission on Environment and Development.1987.Our Common Future. Oxford University Press.

*****

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC06

CORE-VI: MAJOR PRACTICAL - II

Semester	Subject Title	Total Hours	Credit
III & IV	**Semimicroinorganic Qualitative Analysis**	90	3

Semi-Micro Qualitative Analysis

1. Analysis of simple acid radicals: carbonate, sulphate, chloride, bromide, iodide,nitrate
2. Analysis of interfering acid radicals:Fluoride, oxalate, borate,phosphate
3. Elimination of interfering acid radicals and Identifying the groups of basicradicals
4. Analysis of basic radicals (group-wise): Lead, copper, bismuth, cadmium, iron,aluminium, zinc, manganese, nickel, cobalt, calcium, strontium, barium, magnesium,ammonium
5. Analysis of a mixture containing two cations and two anions (of which one is interferingtype)

Each student is expected to do the analysis of at least 10 mixtures.

Book for Reference

1. Venkateswaran V, Veeraswamy R., Kulandivelu A.R., Basic Principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & Sons (1997

UNIVERSITY OF MADRAS

B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC04

CORE-IV: GENERAL CHEMISTRY – III

Learning Outcomes

1. To understand the general characteristics of Nitrogen and Oxygen families.
2. To know about the chemistry of Halogens and noble gases.
3. To learn the mechanism of Nucleophillic substitution and Elimination reactions.
4. To know about the reaction mechanisms of aromatic and heterocyclic compounds.
5. To understand the basic concepts of Thermodynamics and Thermochemistry.

SEMESTER	Subject Title	Total Hours	Credit
III	General Chemistry – III	75	4

UNIT-I: CHEMISTRY OF NITROGEN ANDOXYGENFAMILIES (15hrs)

1.1 Group VA elements: General characteristics of Group VA elements; chemistry of H_2N-NH_2, NH_2OH, HN_3 and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $POCl_3$,P_2O_5 and oxyacids of phosphorous (H_3PO_3 and H_3PO_4).

1.2 Group VIA elements: General properties of group VIA elements - Structure and allotropy of elements-chemistry of ozone - Classification and properties of oxides - oxides of sulphur and selenium - Oxyacids of sulphur (Caro's and Marshall'sacids).

UNITII: CHEMITRY OF HALOGENS AND NOBLEGASES (15hrs)

2.1 Chemistry of Halogens: General characteristics of halogen with reference to electro-negativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine. Halogen acids (HF, HCl, HBr and HI), oxides and oxyacids ($HClO_4$). Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7), pseudo halogens [$(CN)_2$ and $(SCN)_2$] and basic nature of Iodine.

2.2 Noble gases: Position in the periodic table. Preparation, properties and structure of XeF_2, XeF_4, XeF_6 and $XeOF_4$; uses of noble gases- clathrate compounds.

UNIT III: NUCLEOPHILIC SUBSTITUTION AND ELIMINATION REACTIONS (10hrs)

3.1 Nucleophilicsubstitution : S_N1, S_N2 and S_Ni reactions-mechanisms-stereochemistry - effect of solvent, structure of substrate, nucleophilicity of the reagent [nucleophile] and nature of the leaving group.

3.2 Elimination reactions: E1, E2 and E1CB reactions and mechanisms: Hofmann and Saytzeff rules. Elimination vs Substitution.

UNIT IV: BENZENE AND POLYNUCLEARAROMATICHYDROCARBONS (15hrs)

Aromaticity - conditions for aromaticity - resonance stabilization energy - Hückel rule with respect to benzene, naphthalene, anthracene andphenanthrene; Electrophilic substitution in benzene-general mechanism; nitration, sulphonation, halogenations, Friedel-Crafts alkylation and acylation. Orientation [directive influence] and reactivity in mono substituted benzenes. Polynuclear hydrocarbons-naphthalene, anthracene and phenanthrene-preparation, properties and uses.

UNIT V: THERMODYNAMICS-I (20 hrs)

5.1 Terminology of thermodynamics-Thermodynamic equilibrium-nature of work and heat-First law of Thermodynamics-statement-definition of Internal Energy (E), Enthalpy (H) and Heat capacity. Relation between Cp and Cv. Calculation of W, q, dE and dH for expansion of ideal and real gases under isothermal and adiabatic condition of reversible and irreversible processes. Joule- Thompson effect and Coefficient (μ_{JT})-Calculation of μ_{JT} for ideal and real gases - Inversion temperature.

5.2 Thermochemistry - Relation between enthalpy of reaction at constant volume (q_v) and at constant pressure (q_p) - Temperature dependence of heat of reaction - Kirchoff equation-Derivation and application-Enthalpy of formation and combustion - Bond energy and its calculation from thermochemicaldata.

Textbooks :

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th ed., New Delhi, Vishal Publishing Co.,2016.
2. Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 33th ed., New Delhi, Milestone Publishers and Distributors,2016.
3. Soni P.L., and Chawla H.M., Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons, 2007.
4. Jain M K and Sharma S C, Modern Organic Chemistry, Vishal Publications,2018.

Reference Books

1. Lee J.D. Concise Inorganic Chemistry, 5th ed., Blackwell Science,2005.
2. Soni, P.L. and Mohan Katyal. Textbook of Inorganic Chemistry, 20th ed., Sultan Chand & Sons, 2006.
3. Glasstone Samuel. Textbook of Physical Chemistry, 2nd ed., Macmillan India Ltd.,1990.
4. Soni P.L., Dharmarha O.P. and Dash U.N Textbook of Physical Chemistry, 23rd ed., New Delhi, Sultan Chand & Sons,2011.
5. Graham Solomons T.W. Organic Chemistry, 3rd ed., John Wiley &Sons.
6. Morrison R.T. and Boyd R.N., Organic Chemistry, 6th ed., Pearson Education, Asia,2002.

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC05

CORE-V: GENERAL CHEMISTRY-IV

Learning Outcomes

1. To understand the chemistry of Redox reactions.
2. To understand the General characteristics of d-Block elements
3. To learn about the preparation and properties of Heterocyclic compounds and dyes.
4. To know about the nomenclature, preparation and properties of alcohols, thiols, ethers and thioethers.
5. To understand the limitation of I law of thermodynamics and the need of II law of thermodynamics.

SEMESTER	Subject Title	Total Hours	Credit
IV	**General Chemistry –IV**	75	4

UNIT I: CHEMISTRY OFREDOXREACTIONS (10 hrs)

Covalency- oxidation number- oxidation state - difference between oxidation number and valency- rules for calculating oxidation number - definition of oxidation and reduction - redox reactions and half reactions - oxidising agents and reducing agents - equivalent weights of oxidising and reducing agents - auto oxidation and induced oxidation - balancing of redox equations by oxidation number method and ion-electron method

UNIT II: CHEMISTRY OF d-BLOCKELEMENTS (15 hrs)

Transition Elements - Electronic configuration - General periodic trend –Atomic and ionic radii, metallic character, melting and boiling points, ionisation energy, oxidation state, reactivity, colour and tendency to form complexes- Group study of Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel and Zinc groups - galvanization, Evidences for the existence of mercurous ion as Hg_2^{2+}.

UNIT III: HETEROCYCLIC COMPOUNDS AND DYES (15 hrs)

3.1 Heterocycliccompounds

Nomenclature, Preparation, properties and reactions of Furan, Pyrrole, Thiophene and Pyridine.Comparative study of basicity of pyrrole and pyridine with aliphatic amines. Synthesis and reactions of Indole, Quinoline and Isoquinoline

3.2 Dyes

Theory of colour and constitution. Preparation and uses of: Azo dye - Bismark brown, Triphenyl methane dye - malachite green, phthalein dye - fluorescein,anthrquinone dye- alizarin and vat dye- indigo.

UNIT IV:

4.1 Alcoholsandthiols (15 hrs)

Monohydric, dihydric (Ethylene glycol)andtrihydric (Glycerol) alcohols: Nomenclature, preparation of alcohols from alkenes, alkyl halides, Grignard reagent and carbonyl compounds. Reactions of alcohols-Dehydration, oxidation, action of Grignard reagent, dehydrogenation using copper and esterification.
Thiols: Nomenclature, structure, preparation and properties

4.2 Ethers and thioethers

Ethers: Nomenclature, structure, preparation, properties and uses of dimethyl ether, diethyl ether, ethyl methyl ether, anisole and phenetole.
Thioethers: Nomenclature, structure, preparation, properties and uses.

UNIT5:Thermodynamics-II (20 hrs)

Second Law of Thermodynamics - Limitations of first law & Need for the second law - Different statements of the law - Carnot's cycle and efficiency of heat engine-Carnot's theorem- Concept of Entropy - Definition and physical significance of entropy - Entropy as a function of P, V and T- Entropy changes during phase changes - Entropy of mixing- Gibb's free energy (G) and Helmholtz free energy (A) - Variation of A and G with P, V and T - Gibb's Helmholtz equation and its applications - Thermodynamic equation of state - Maxwell's relations.

Text Books

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 44th ed., New Delhi, Vishal Publishing Co.,2009.
2. Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 30th ed., New Delhi, Milestone Publishers and Distributors,2009.
3. Soni P.L., and Chawla H.M., Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons, 2007.
4. Jain M.K, Sharma S.C. Modern Organic Chemistry, Vishal Publishing Co.,2018

Books for References

1. Glasstone S. And Lewis D., Elements of Physical Chemistry, 2nd ed., MacMillan & Co. Ltd., London.
2. Morrison R.T. and Boyd R.N., Organic Chemistry, 6th ed. Pearson Education, Asia,2002
3. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, 12th ed., Sultan Chand & Co., New Delhi, 1997.
4. Madan R.D. SathyaPrakash's Modern Inorganic Chemistry, 2nd ed., S.Chand& Co. Ltd, New Delhi, 1990.

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC13

CORE-XIII: MAJOR PRACTICAL-III

Learning the gravimetric estimation of some anions and cautions

Semester	Subject Title	Total Hours	Credit
V & VI	**Inorganic Quantitative Analysis - Gravimetric Analysis**	90	4

1. Estimation of Lead as Leadchromate
2. Estimation of Barium as Barium chromate
3. Estimation of Nickel as Nickel - DMG complex.
4. Estimation of Calcium as Calciumoxalate
5. Estimation of Barium as Barium sulphate
6. Estimation of Sulphate as Bariumsulphate.
7. Estimation of Aluminium as Aluminium oxinate (for demonstration)
8. Estimation of Silver as Silver chloride (fordemonstration)

Books for References

1. Venkateswaran, V. Veeraswamy R. Kulandaivelu A.R., Basic Principles of Practical Chemistry, 2nd Edition, New Delhi, Sultan Chand & Sons,(1997).
2. Jeffery G.H., Bassett J., Mendham J. And Denney R.C, Vogel's Text book of Quantitative Chemical Analysis, 5th ed., John Wiley & Sons Inc., New York,1989.

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC14

CORE-XIV: MAJOR PRACTICAL - IV

Learning to identify functional groups and elements present in organic compounds; Preparation of some simple organic compounds

Semester	Subject Title	Total Hours	Credit
V & VI	**Organic Analysis and Preparation**	90	4

ORGANIC ANALYSIS

Analysis of simple organic compounds (a) characterization functional groups (b) confirmation by preparation of solids derivatives / characteristics colour reaction.

Note : 1. Mono - functional compounds are given for analysis. Incase of bi-functional compounds, students are required to report any one of the functional groups.

2. Each student is expected to do the analysis of at least 10 different organic substances. Recommended to adopt micro scale technique of organic analysis

ORGANIC PREPARATIONS

Preparation of Organic compounds involving the following chemical conversions

1. Oxidation ofbenzaldehyde
2. Reduction ofnitrobenzene
3. Esterification of salicylicacid
4. Acetylation ofaniline
5. Hydrolysis of methylsalicylate
6. Nitration ofphenol
7. Bromination ofacetanilide

Books for Reference

1. Venkateswaran V, Veeraswamy R and KulandaiveluAR,Basic Principles of Practical Chemistry, 2nd ed., New Delhi, Sultan Chand & Sons(1997).
2. Furniss, B.S., et al. Vogel's Textbook of Practical Organic Chemistry, 5thed.,Prentice Hall,1989.
3. College Practical Chemistry, V K Ahluwalia;Sunita Dhingra;Adarsh Gulati, Universities Press Private Limited, Chennai,2005
4. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis, V K Ahluwalia;Renu Aggarwal, Universities Press Private Limited, Chennai,2004

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC15

CORE-XV: MAJOR PRACTICAL-V

Learning determination of order of chemical reactions; potentiometric and conductometric titrations

Semester	Subject Title	Total Hours	Credit
V & VI	**Physical Chemistry**	90	4

Physical Chemistry Experiments

1. Critical Solution Temperature
2. Effect of impurity on critical solution temperature of phenol-watersystem[NaCl]
3. Rastmethod
4. Transition temperature
5. Heat of neutralization
6. Phase diagram (Simple Eutectic)
7. Kinetics of saponification
8. Kinetics of acid catalyzed ester hydrolysis
9. Kinetics of Persulphate- Iodide reaction.
10. Partition coefficient and Equilibrium constant of $KI + I_2 \rightarrow KI_3$
11. Determination of cell constant, specific conductance and equivalent conductance of strong electrolyte.
12. Estimation of HCl by conductometric titration
13. Estimation of acetic acid conductometric titration
14. Estimation of $BaCl_2$ by conductometric titration.
15. Estimation of HCl by potentiometric titration
16. Estimation of FAS by potentiometrictitration

Books for Reference

1. Venkateswaran, V. Veeraswamy R., Kulandaivelu A.R., Basic Principles of Practical Chemistry, 2nd ed., Sultan Chand & Sons,1997.
2. Daniels et al., Experimental Physical Chemistry, 7th ed., McGraw Hill,1970.
3. Findlay, A., Practical Physical Chemistry, 7th ed., Longman,1989.
4. Ahluwalia, V.K., Dingra, S. and Gulati, A. College Practical Chemistry, Orient Longman Pvt. Ltd., Hyderabad2005.
5. Sharma, K.K. and Sharma, D.S. Introduction to Practical Chemistry, Vikas Publishing House, New Delhi,2005).

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC07

CORE-VII: INORGANIC CHEMISTRY – I

Learning Outcomes

1. Learning the unique characteristics of lanthanide and actinide series
2. Learning the fundamentals of coordination chemistry and its applications in analytical chemistry ; Understanding the biological importance of complexes
3. Learning the theories of acids and bases

Semester	Subject Title	Total Hours	Credit
V	**INORGANIC CHEMISTRY – I**	60	4

UNIT I: CHEMISTRY OF f-BLOCKELEMENTS (15 hrs)

General characteristics of f-block elements - Comparative account of lanthanides and actinides - Occurrence, Oxidation states, Magnetic properties, Colour and spectra - Lanthanides and Actinides Separation by ion-Exchange and Solvent extraction methods - Lanthanide contraction-Chemistry of thorium and Uranium-Occurrence, Ores, Extraction, properties and uses - Preparation, Properties and uses of ceric ammonium sulphate, thorium dioxide and uranyl acetate.

UNIT II:COORDINATION CHEMISTRY (15 hrs)

Types of ligands, IUPAC Nomenclature, Isomerism - Ionisation, hydrate, linkage, ligand and coordination isomerism. Stereoisomerism-geometrical and optical isomerism in 4 & 6 coordinated complexes. Theories of coordination compounds - Werner and Sidgwick EAN concept , ValenceBond theory - hybridisation, geometry and magnetic properties of $[Ni(CN)_4]^{2-}$, $[NiCl_4]^{2-}$, $[Fe(CN)_6]^{4-}$, $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$. Crystal field theory – spectrochemicalseries, splitting of d- orbitals in octahedral and tetrahedral complexes, low spin & high spin complexes. Explanation of colour and magnetic properties using CFT, comparison of VBT andCFT.

UNITIII:APPLICATIONOFCOORDINATIONCOMPOUNDS (12 hrs)

Application of coordination compounds - Estimation of nickel using DMG and aluminium using oxine . Estimation of hardness of water using EDTA . Biologically important coordination compounds - Chlorophyll, haemoglobin, vitamin - B_{12} . (their structure and applications). Metal Carbonyls : Mono and Poly nuclear Carbonyls of Ni, Fe, Cr, Co and Mn- Synthesis, structures and bonding.

UNIT IV: CHEMISTRY OFBINARYCOMPOUNDS (10 hrs)

Classification, preparation, properties and uses of hydrides, borides, carbides and nitrides

UNIT V: CONCEPTS OF ACIDSANDBASES (8 hrs)

Theories of acids and bases - Arrhenius theory, Bronsted- Lowry theory - basicity of an acid and acidity of a base - relative strengths of acids and bases, Cady - Esley concept - general theory of solvent system, Lux - Flood concept - Lewis acids - bases concept in coordination chemistry - classification of Lewis acids, Usanovich concept. Concept of Hard and Soft Acids and Bases (HSAB). Types of solvents: Protic and aprotic solvents-aqueous and non aqueous solvents-liquid ammonia and liquid HF as solvents.

TEXT BOOK

1. Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 33rd ed., New Delhi,Mile stone publishers and distributers,2016.
2. Textbook of Inorganic Chemistry, R Gopalan, Universities Press Private Limited, Chennai,2009

BOOKS FOR REFERENCE

1. Lee J.D., Concise Inorganic Chemistry, 5th ed., Blackwell Science,2005.
2. Sharpe Alan G. Inorganic Chemistry, ELBS andLongman,1981.
3. Soni P.L., and Mohan Katyal, Text book of Inorganic Chemistry, 20th ed., S.Chand& Co., New Delhi,2006.
4. Malik Wahid U., Tuli G.D. and Madan R.D., Selected Topics in Inorganic Chemistry, 7th ed., S.Chand&Company Ltd., New Delhi,2007.
5. James EHuheey, Ellen AKeiter, Richard LKeiter and OkhilKMedhi, Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Pearson India,2011.
6. Gurdeep Raj Chatwal and Harish Mehre, Advanced Inorganic Chemistry, 7th ed., Goel Publishing House,Meerut.

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC08

CORE-VIII: ORGANIC CHEMISTRY – I

Learning Outcomes

1. Understanding acidic nature of phenol and its properties
2. Learning the reactions of aldehydes and ketones
3. Learning the chemistry of carboxylic acids and their derivatives
4. Learning the chemistry of nitro compounds and amines
5. Learning the basics of green chemistry.

Semester	Subject Title	Total Hours	Credit
V	ORGANIC CHEMISTRY -I	60	4

UNIT-I:CHEMISTRY OF PHENOLS ANDAROMATIC ALCOHOLS (12 hrs)

Phenols: Nomenclature, synthesis of phenol from benzene sulphonic acid, chlorobenzene and cumene - Properties - Acidity of phenols and substituted phenols (explanation on the basis of resonance stabilization). Reactions similar to those of alcohols, ring substitution in phenol- orientation of phenolic group towards electrophiles, halogenation, nitration and sulphonation,Libermann nitroso reaction, mechanism of Riemer-Tiemann reaction, Kolbe-Schmidt reaction and coupling with diazonium salts and condensation reactions. Alkylation and acylation of phenols.

Dihydric phenols and benzyl alcohols-preparation, properties and uses

UNIT-II: CHEMISTRY OFCARBONYLCOMPOUNDS. (15 hrs)

Nomenclature, structure of carbonyl compounds, acidity of alpha-hydrogen atom, keto- enolTautomerism (proof for the two forms). Mechanism of nucleophilic addition with HCN, ROH, $NaHSO_3$, ammonia (NH_2OH, $NH_2NH_2$and $C_6H_5NHNH_2$).Mechanism of Meerwein-Pondorf-Verley reduction, Clemmenson reduction, Wolf-Kishner reduction, aldol condensation, Claisen-Schmidt reaction, Cannizaro reaction, haloform reaction, Perkin and Benzoin condensation reaction - Diekmann condensation.

UNIT-III: CHEMISTRY OF CARBOXYLIC ACIDS AND THEIR DERIVATIVES (12 hrs)

Acidity of carboxylic acids, Effect of substituents on acidity, comparison of acid strengths of halogen substituted acetic acid and substituted benzoic acid.

Dicarboxylic acids: General methods of preparation - from alkyl cyanides, cyclic ketones and halo esters. Reactions - action of heat, action of PCl_5 and NH_3.

Acid derivatives (Aliphatic): Synthesis and important properties of acid derivatives (acid chlorides, acid anhydrides, esters and amides). Acetoacetic and malonic esters-Preparation and synthetic applications.

UNIT-IV: CHEMISTRY OFNITROGENCOMPOUNDS (12hrs)

Nitrobenzene- preparation, reduction in different media, conversion of nitrobenzene to m- dinitrobenzene and TNT. Amines: Nomenclature, Basicity of amines, effect of substituents on basicity of aliphatic and aromatic amines. Preparation of primary amines by Gabriel synthesis and reduction of nitriles, secondary and tertiary amines-by the reduction of N-alkyl substituted amides. Reactions of amines-primary aliphatic and aromatic amines with nitrous acid, diazotization, coupling and carbylamines reactions.

UNIT - V: GREEN CHEMISTRY (9 hrs)

Concept and principles of green chemistry – need of green chemistry –Atom economy reactions (substitution, elimination, hydrogenation, addition and rearrangement reaction – basic concepts only)-green solvents-types and simple applications.

Green Catalysis – Heterogeneous – use of zeolites, silica, alumina, supported catalysis –bio catalysis: Enzymes, microbes, phase transfer catalysis (miscellar / surfactant).

Microwave, ultrasound and light promoted reactions (few examples for each type).

TEXT BOOKS

1. ArunBahl and Bahl B.S., A Text book of Organic Chemistry, S.Chand Publishing,2016.
2. Soni, P.L., and Chawla H.M., Text book of Organic Chemistry, 29thed., New Delhi, Sultan Chand & Sons, 2007.
3. Textbook of Organic Chemistry, C N Pillai, Universities Press Private Limited, Chennai,2010

REFERENCE BOOKS:

1. Jain M.K, Sharma S.C. Modern Organic Chemistry, Vishal Publishing Co.,2018
2. Morrison, R.T. and Boyd R.N., Organic Chemistry, 6thed., Pearson Education, Asia2002.
3. Environmental Chemistry with green chemistry by Asim.K.Das, Books and Allied Pvt. Ltd., Reprint 2015.
4. Graham Solomons T.W., Organic Chemistry, 3 rd ed., John Wiley &Sons.
5. Carey Francis A., Organic Chemistry , 7th ed., New Delhi, Tata McGraw Hill Education Pvt Ltd., 2009.
6. Finar I.L., Organic Chemistry, 6th, Vol.(1& 2), England, Wesley Longman Ltd.1996.
7. John E. McMurry, Organic Chemistry, 9th ed., Cengage Learning,2015.
8. Agarwal O.P., Organic Chemistry Reactions & Reagents, 49th ed., Goel Publishing House,2014.

UNIVERSITY OF MADRAS

B.Sc. DEGREE COURSE IN CHEMISTRY

SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSE1A

ELECTIVE-I(A): PHARMACEUTICAL CHEMISTRY

Learning Outcome

Learning various terminologies in pharmacology; Types of drugs and their action

Semester	Subject Title	Total Hours	Credit
V	**Pharmaceutical Chemistry**	60	5

UNIT I (12 hrs)

Important terminologies used in pharmaceutical chemistry - drug pharmacology, pharmacognosy, pharmacodynamics, pharmacokinetics, antimetabolites, pharmacopeia (BP,IP,USP), National formulary, chemotherapy, vaccines, primary immunization, synergism, antagonist LD50, ED50, therapeutic index and drug dosage.

Various sources of drugs, pharmacologically active constituents in plants. Classification of drugs, chemical –biological - mechanism of drug action - action at cellular sites. Drug receptors and biological responses. Mechanism of different types of drug action.

UNIT II (12 hrs)

Absorption of drugs - factors affecting absorption of drugs, routes of administration - local, enema, oral and external, parental routes - advantages and disadvantages –

Common diseases - infective diseases insect borne - air borne and water borne. Common diseases of the respiratory system and nervous system.

Indian medicinal plants - tulsi, neem, keezhanelli. AIDS - symptoms and prevention.

UNIT III (12 hrs)

Anaesthetics - general - ether, chloroform, ethyl chloride, halothane, nitrous oxide, local - esters - cocaine, benzococaine, procaine, amides - lignocaine, cinchocaine. Analgesics - Narcotic and synthetic

Antipyretics and anti-inflammatory agents, Antibiotics - penicillin, streptomycin, chloramphenicol, tetracycline.Antiseptics and disinfectants - phenol and its derivatives, nitrofuran derivatives.

UNIT IV (12 hrs)

Composition of blood - blood grouping and matching. Blood pressure - systolic and diastolic - hypertensive drugs. Diabetes - causes - hyperglycemic drugs.

Cardiovascular drugs - cardiac glycosides - antiarrhythemic drugs, antianginal drugs, vasodialators, antipsychedelic drugs - antidepressants - sedatives and hypnotics.

UNIT V (12 hrs)

Anticonvulsant agents - Barbiturates –oxazolinediones- acetyl urea derivatives - succinimides.Diagnosticagents for kidney function (aminohippuric acid) –for liver function (sulfobromophthalein).Lipid profile - HDL, LDL, cholesterol and lipid lowering drugs.

Vitamins - fat soluble and water soluble - sources, biological role and deficiency conditions.

Medicinal importance of inorganic compounds - compounds of aluminium - phosphorus - arsenic - mercury and Iron.Biological importance of inorganic compounds - sodium and its compounds - potassium and its compounds - copper and its compounds.

REFERENES

1. JayashreeGhosh, A Text book of Pharmaceutical Chemistry, 5th ed., S Chand&Company Ltd., 2014.
2. Lakshmi S, Pharmaceutical Chemistry, S Chand& Sons, New Delhi,1995.
3. AshuttoshKar, Medicinal Chemistry, Wiley Eastern Ltd., New Delhi,1993.
4. Hakishan, V.K. Kapoor, Medicinal and Pharmaceutical Chemistry, VallabhPrakashan,2012.

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC09

CORE-IX: PHYSICAL CHEMISTRY – I

Learning Outcomes

1. Introduced to concepts of thermodynamics such as equilibrium constant and entropy
2. Learning fundamental concepts about solutions and the basis of separation techniques such as steam distillation and solvent extraction
3. Introduced to phase rule and its application to one component and two component systems
4. Introduced to colligative properties and methods of their determination
5. Introduced to the concept of conductance in electrochemistry

Semester	Subject Title	Total Hours	Credit
V	**PHYSICAL CHEMISTRY - I**	60	4

UNIT I: THERMODYNAMICS III (12 hrs)

Equilibrium constant and free energy change - Thermodynamic derivation of law of mass action - Equilibrium constants in terms of pressure and concentration (K_p and K_c) and their relation - Thermodynamic interpretation of Lechatelier principle (Concentration, temperature, pressure and addition of inert gases). Systems of variable composition - Partial molar quantities - Chemical potential - Variation of chemical potential with T, P and X (mole fraction) - Gibbs-Duhem equation- Duhem-Margules equation.van't Hoff reaction isotherm - van't Hoff's isochore- Clapeyron equation and Clausius- Clapeyron equation - Applications-

Nernst heat theorem - Third Law of Thermodynamics - Statement of third law and concept of residual entropy - Evaluation of absolute entropy from heat capacity data- exception to third law (CO, ortho and para hydrogen).

UNIT II: SOLUTIONS (12hrs)

Ideal and Non-ideal solutions. Concept of activity and activity coefficients - Completely miscible liquid systems - benzene and toluene.Raoult's law and Henry's law. Deviation from Raoult's law and Henry's law.Azeotropes- HCl-water and Ethanol-water system - Partially miscible liquid systems (Upper and lower CST) - phenol-water, triethylamine-water and Nicotine-water systems. Completely immiscible liquids –principle and applications of steam distillation - Nernst Distribution Law- thermodynamic derivation, application to solvent extraction, limitations of distribution law

UNIT III: THERMODYNAMICS OF PHASE TRANSITIONS (10 hrs)

Definition of terms in the phase rule - Derivation and application to one component system water and sulphur - super cooling, sublimation. Two component systems - reduced phase rule - solid-liquid equilibria, simple eutectic (lead-silver), desilverisation of lead –Compound formation with congruent melting point. (Mg-Zn) and incongruent melting point (Na-K).Solid solutions - (Ag- Au) - freezing mixtures - KI-H_2O system.

UNIT IV: DILUTE SOLUTIONS AND COLLIGATIVE PROPERTIES (10 hrs)

Colligative properties - relative lowering of vapour pressure, osmosis - Law of osmotic pressure-isotonic solutions, effect of concentration and temperature on osmotic pressure - thermodynamic derivation of elevation of boiling point and depression in freezing point - determination of molecular masses using the above properties [experimental details not required]- abnormal molecular masses and van't Hoff factor - degree of association and degree of dissociation.

UNIT V: ELECTRO CHEMICAL CONDUCTANCE (16 hrs)

Electrical transport and conductance in metal and in electrolytic solution. Specific conductance and equivalent conductance. Measurement of equivalent conductance. Using Kohlraush' sbridge. Arrhenius theory of electrolytic dissociation and its limitations. Weak and strong electrolyte according to Arrhenius theory Ostwald's dilution laws- applications and limitation. Variation of equivalent conductance with concentration. Migration of ion-ionic mobility. Kohlraush's law and its applications. The elementary treatment of the Debye- Hückel Onsager equation for strong electrolytes. Evidence for ionic atmosphere. Wein effect and Debye-Falkenhagen effect. Transport number - Determination by Hittorf method and moving boundary method. Application of conductance measurements- Determination of $\Lambda_0$of strong electrolytes. Determination of K_a of weak acids. Determination of solubility product of a sparingly soluble salt. Conductometrictitrations.

TEXT BOOK

1. Puri B.R., Sharma L.R., Pathania M.S., Principles of Physical Chemistry, 47th ed., Vishal Publishing Co., 2016.
2. Textbook of Physical Chemistry, M V Sangaranarayanan;V Mahadevan, Universities Press Private Limited, Chennai,2011

REFERENCE BOOKS

1. Atkins P.W., Physical Chemistry, 5th ed., Oxford Universities Press Private Limited,1994.
2. Castellan G.V., Physical Chemistry, New Delhi, OrientLongmans.
3. Levine I.N., Physical Chemistry 6th ed.,2009.
4. Rajaram J. and Kuriacose J.C., Thermodynamics for students of chemistry 3rd ed., ShobanLal& Co., 2013.
5. Bajpai D.N., Advanced Physical Chemistry, S.Chand Publishing, 2001.
6. Negi A.S. and Anand S.C., A Textbook of Physical Chemistry, John Wiley & Sons Pvt. Ltd.,1986.

UNIVERSITY OF MADRAS
U.G. DEGREE COURSE

PART – IV - VALUE EDUCATION

Common for all U.G. & Five Year Integrated Courses
(Effective from the Academic Year 2012 – 2013)

SYLLABUS

CREDITS: 2 **III YEAR / V SEM**

Objective: Value are socially accepted norms to e valuate objects, persons and situations that form part and parcel of sociality. A value system is a set of consistent values and measures. Knowledge of the values are inculcated through education. It contributes in forming true human being, who are able to face life and make it meaningful. There are different kinds of values like, ethical or moral values, doctrinal or ideological values, social values and aesthetic values. Values can be defined as broad preferences concerning appropriate courses of action or outcomes. As such, values reflect a person's sense of right and wrong or what "ought" to be. There are representative values like, "Equal rights for all", "Excellence deserves admiration". "People should be treated with respect and dignity". Values tend to influence attitudes and behavior and help to solve common human problems. Values are related to the norms of a culture.

UNIT I: Value education-its purpose and significance in the present world – Value system – The role of culture and civilization – Holistic living – balancing the outer and inner – Body, Mind and Intellectual level – Duties and responsibilities.

UNIT II: Salient values for life – Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, and inclusiveness, Self esteem and self confidence, punctuality – Time, task and resource management – Problem solving and decision making skills – Interpersonal and Intra personal relationship – Team work – Positive and creative thinking.

UNIT III: Human Rights – Universal Declaration of Human Rights – Human Rights violations – National Integration – Peace and non-violence – Dr.A P J Kalam's ten points for enlightened citizenship – Social Values and Welfare of the citizen – The role of media in value building.

UNIT IV: Environment and Ecological balance – interdependence of all beings – living and non-living. The binding of man and nature – Environment conservation and enrichment.

UNIT V: Social Evils – Corruption, Cyber crime, Terrorism – Alcoholism, Drug addiction – Dowry – Domestic violence – untouchability – female infanticide – atrocities against women – How to tackle them.

Books for Reference :

1. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003.
2. Chakravarthy, S.K: Values and ethics for Organizations: Theory and Practice, Oxford University Press, New Delhi, 1999.
3. Satchidananda, M.K: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991.
4. Das, M.S. & Gupta, V.K.: Social Values among Young adults: A changing Scenario, M.D. Publications, New Delhi, 1995.
5. Bandiste, D.D.: Humanist Values: A Source Book, B.R. Publishing Corporation, Delhi, 1999.
6. Ruhela, S.P.: Human Values and education, Sterling Publications, New Delhi, 1986.
7. Kaul, G.N.: Values and Education in Independent Indian, Associated Publishers, Mumbai, 1975.
8. NCERT, Education in Values, New Delhi, 1992.
9. Swami Budhananda (1983) How to Build Character A Primer : Rmakrishna Mission, New Delhi.
10. A Culture Heritage of India (4 Vols.), Bharatiya Vidya Bhuvan, Bombay, (Selected Chapters only)
11. For Life, For the future : Reserves and Remains – UNESCO Publication.
12. Values, A Vedanta Kesari Presentation, Sri Ramakrishna Math, Chennai, 1996.
13. Swami Vivekananda, Youth and Modern India, Ramakrishna Mission, Chennai.
14. Swami Vivekananda, Call to the Youth for Nation Building, Advaita Ashrama, Calcutta.
15. Awakening Indians to India, Chinmayananda Mission, 2003.

******

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSE3A

ELECTIVE-III(A): ANALYTICAL CHEMISTRY

Learning Outcome
Learning terminology; Separation techniques; Principles and instrumentation of chromatographic, gravimetric, thermal, spectroscopic and electroanalytical techniques.

Semester	Subject Title	Total Hours	Credit
VI	**Analytical Chemistry**	75	5

UNIT-I **(10hrs)**

Data Analysis - Theory of errors - idea of significant figures and its importance with examples - Precision - accuracy - methods of expressing accuracy - error analysis - minimizing errors methods of expressing precision - average deviation - standard deviation and confidence limit.

Purification of solid compounds - extraction - use of immiscible solvents - soxhlet extraction Purification of liquids - experimental techniques distillation - fractional distillation - vacuum distillation - steam distillation –tests for purity.

UNIT-II **(20hrs)**

Principles of gravimetric analysis - characteristics of precipitating agents-
choice of precipitants and conditions of precipitation –specific and selective precipitants - DMG, cupferron, salicylaldehyde, ethylendediamine- use of sequestering agents - co-precipitation - post precipitation - peptisation- differences- reduction of error - precipitation from homogeneous solutions - calculations in gravimetric methods - use of gravimetricfactor.

Thermal analytical methods - Principle involved in thermogravimetric analysis and differential gravimetric analysis - discussion of various components with Block diagram - characteristics of TGA and DTA - factors affecting TGA and DTA curves- thermometric titrations.

Chromatography Techniques - Principles - adsorption, partition and ion exchange chromatography , column chromatography - adsorbents - preparation of column - elution, recovery of substance and applications. TLC - choice of adsorbent and solvent - preparation of chromatogram (R_f value) and applications - Paper chromatography - Solvents used - factors affecting $R_f$value- separation of amino acidmixtures.

UNIT-III **(15hrs)**

Definition of spectrum - electromagnetic radiation - quantisation of different forms of energies of molecules - translational, vibrational, rotational, vibrational and electronic energies.

UV - Visible spectroscopy - absorption laws –theory- electronic spectra - types of electronic transitions - chromophores and auxochromes –absorption bands and intensity - factors governing absorption maxima and intensity - instrumentation

IR spectroscopy - vibrations of diatomic molecules- harmonic and anharmonic oscillators, zero point energy,force constant, condition for a molecule to be IR active, selection rules - instrumentation

UNIT-IV **(15 hrs)**

NMR spectroscopy - principle - equivalent and non-equivalent protons - shielded and deshielded protons, chemical shift - TMS, delta tau scales, spin-spin coupling- analysis of spectrum of ethanol - instrumentation

Mass spectrometry:

Basic principles of mass spectrum Instrumentation and Block diagram molecular ion peak, base peak, isotopic peak, fragmentation - Nitrogen rule - determination of molecular formulae - fragmentation and mass spectrum of simple organic compounds - alcohols and carbonyl compounds- McLaffertyrearrangement.

UNIT–V **(15 hrs)**

Polarography - principle - concentration polarization - dropping mercury electrode - advantages and disadvantages - migration and diffusion currents - Ilkovic equation (derivation not required) and significance - experimental assembly –electrodes - capillary - current voltage curve - oxygen wave - influence of temperature and agitation on diffusion layer - polarography as an analytical tool in quantitative and qualitative analysis . Amperometry- basic principles and uses

References

1. Gopalan R., Rengarajan K., and Subramanian P.S., Elements of Analytical Chemistry, 3rd ed. Reprint, Sultan Chand & Sons,2013.
2. SkoogDA, West DM, James Holler F and Stanley R, Fundamentals of Analytical Chemistry,9th ed., 2013
3. Khopkar S.M., Analytical Chemistry, New AgeInternational.
4. Analytical Methods: Interpretation, Identification, Quantification, R Gopalan and K S Viswanathan, Universities Press Private Limited, Chennai,2018
5. Analytical Chemistry, G L David Krupadanam;D Vijaya Prasad;K Varaprasad Rao;K L N Reddy;C Sudhakar, Universities Press Private Limited, Chennai,2001

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC10

CORE-X: INORGANIC CHEMISTRY – II

Learning Outcomes

1. Learning the theories of metallic bonding
2. Introduced to organometallic compounds
3. Introduced to fundamental concepts of nuclear chemistry and radioactivity
4. Learning the chemistry of clathrates, phosphazenes, silicates

Semester	Subject Title	Total Hours	Credit
VI	INORGANIC CHEMISTRY – II	75	5

UNIT I: METALLIC BONDING (15hrs)

Metallic state - Packing of atoms in metal (BCC , FCC , HCP and simple cube) - Theories of metallic bonding - Electron gas , Pauling and band theories - Semi conductors- n- type and p- type, transistors - Uses - superconductors - examples, types - structures of alloys - substitutional and interstitial solid solutions- Hume-Rothery ratio.

UNIT II: CHEMISTRY OF ORGANOMETALLIC COMPOUNDS (15 hrs)

Introduction - Preparation, properties uses of Organomagnesium, Organozinc, Organolithium,Organocopper, Organolead, Organophosphorus and Organoboroncompounds. Preparation, properties, uses and structure of ferrocene- Preparation and uses of Ziegler-Natta catalyst.

UNIT III: NUCLEAR CHEMISTRY (15hrs)

Introduction - composition of nucleus - nuclear binding energies –structure of nucleus- nuclear shell model and liquid drop model - magic numbers - nuclear stability - theories of nuclear stability - nuclear binding energy theory - meson theory of nuclear forces - nuclear fluid theory - isotopes, isobars, isotones, nuclear isomers and mirror nuclei - detection of isotopes –Aston's mass spectrograph separation of isotopes - electromagnetic method - the whole number rule and packing fraction.

UNIT IV: RADIOACTIVITY (15 hrs)

Radioactive Emanations, Alpha rays, Beta rays and Gamma rays. The Disintegration theory- Group Displacement Law. Rate of disintegration and Half-life period. Radioactive disintegration series. The Gieger- Nuttal rule - Artificial radioactivity. Induced radioactivity. Nuclear fission-Atom bomb, Nuclear fusion-hydrogen bomb- Stellar energy - Hazards of radiation. Applications of Radioisotopes. Radiocarbon dating.

UNIT V: SOME SPECIAL TYPEOFCOMPOUNDS (15 hrs)

Clathrates - examples and structures, interstitial and non-stoichiometric compounds –composition, manufacture, structure, properties and uses ofphospazenes –composition and uses of beryl, asbestos, talc, mica, zeolites andultramarines.

TEXT BOOK

1. Puri, B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 30th ed., Mile stone publishers and distributers, 2009.

BOOKS FOR REFERENCE

1. Lee J.D., Concise Inorganic Chemistry.5th ed., BlackwellScience,2005.
2. Sharpe Alan G. Inorganic Chemistry .ELBS andLongman,1981.
3. Miessler G. L. and Donald, A. Tarr, Inorganic Chemistry 4th ed., Pearson,2010.
4. Malik, Wahid U., Tuli G.D. and Madan R.D., Selected Topics in Inorganic Chemistry,7thed., S.Chand& Company Ltd.,2007.
5. Gurdeep Raj Chatwal and Harish Mehre, Advanced Inorganic Chemistry, 7th ed., Goel Publishing House,Meerut

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC11

CORE-XI: ORGANIC CHEMISTRY –II

Learning Outcomes

1. Learning the chemistry of biopolymers – carbohydrates and proteins
2. Understanding vitamins
3. Learning the chemistry of natural products – alkaloids and terpenoids
4. Learning the mechanism of various types of molecular rearrangement
5. Introduced to the concepts of stereochemistry

Semester	Subject Title	Total Hours	Credit
VI	ORGANIC CHEMISTRY –II	75	5

UNIT I: CHEMISTRY OF CARBOHYDRATES (15 hrs)

Carbohydrates –Definition and Classification of carbohydrates with examples. Mono saccharides- glucose and fructose - epimers and anomers with examples.Mechanism muta rotation, osazoneformation.Absolute configurations of glucose and fructose.Structural elucidation of glucose and fructose (including cyclic and Haworth structure).Interconversions, ascending and descending the sugar series.Disaccharide - Sucrose, Maltose - Structural elucidation. Polysaccharide - Starch and Cellulose (Elementary treatment).

UNIT II: CHEMISTRY OF PROTEINS AND VITAMINS (15 hrs)

Amino acids - Classification, General methods of preparation and reactions, zwitter ion, isoelectric point.Peptides and proteins - Peptide linkage- Preparation of dipeptides by Bergmann's method Classification of proteins, primary structure (End group analysis - Sanger's method and Edman method) - secondary structure, tertiary structure, denaturation.

Vitamins - Classification, biological importance of Vitamins. Structure of vitamin C.

UNIT III: CHEMISTRY OF ALKALOIDS AND TERPENOIDS (15 hrs)

Chemistry of natural products - Alkaloids - Isolation, classification, general methods of elucidating structure.Structural elucidation of nicotine and piperine.Terpenes- classification , isoprene rule, special isoprene rule - isolation and structural elucidation of citral, α- terpeniol and menthol.

UNIT IV: MOLECULAR REARRANGEMENTS (10 hrs)

Molecular rearrangements - Types of rearrangements, Mechanisms for the following rearrangements :pinacol- pinacolone, benzil- benzilic acid, benzidine, Favorskii, Claisen, Fries, Hofmann, Curtius, Schmidt and Beckmann.

Unit-V: STEREOCHEMISTRY OF ORGANIC COMPOUNDS (20 hrs)

Stereoisomerism - definition, classification into geometric and optical isomerism. Optical isomerism - Optical activity, asymmetric centre(chirality), symmetry elements (σ_n, S_n and i), relative and absolute configurations, concept of enantiomerism and diastereoisomerism; Racemisation - methods of Racemisation (by substitution and tautomerism), Resolution - methods of resolution (by mechanical, seeding and biochemical),Walden inversion. Projection formulae- Fischer, flying wedge, Sawhorse and Newmann projections, notation of optical isomerism: Cahn- Ingold and Prelog rules, R and S notations for one and two chirality (stereogenic) centres, erythro and threo representations. Geometrical isomerism: cis - trans; syn- anti; E - Zdescriptors.

TEXTBOOK

1. Bahl BS and ArunBahl, Advanced Organic Chemistry, 12th ed., Sultan Chand and Co., New Delhi, 1997.
2. Chemistry of Natural Products: A Unified Approach, N R Krishnaswamy, Universities Press Private Limited, Chennai,2010

BOOKS FOR REFERENCE

1. Finar IL, Organic Chemistry, Vol. 1&2, 6th ed., Addison Wesley Longman Ltd., London,1996.
2. Morrison RT, Boyd RN, Organic Chemistry, 4th ed., Allyn& Bacon Ltd., New York,1976.
3. Pine SH, Organic Chemistry, 4th ed., McGraw-Hill International Book Company,(1986)
4. Peter Sykes A, Guidebook to Mechanism in Organic Chemistry, 6thed.,Pearson Education,2003.
5. Kalsi PS, Stereochemistry of Organic Compounds: Principles and Applications, New Age International,2011.
6. Sujata V Bhat, Nagasampagi BA, and MeenakshiSivakumar, Chemistry of Natural Products, Springer,2006.
7. Agarwal OP, Organic Chemistry Reactions & Reagents, 49th ed., Goel Publishing House,2014.
8. Ahluwalia, V.K., Kidwai, M., New trends in Green Chemistry, 1st ed., Anamaya Publishers, New Delhi,2004.
9. Anatas P.T., and Warner J.C., Green Chemistry Theory andPractice

UNIVERSITY OF MADRAS

B.Sc. DEGREE COURSE IN CHEMISTRY

SYLLABUS WITH EFFECT FROM 2020-2021

BCY-DSC12

CORE-XII: PHYSICAL CHEMISTRY- II

Learning Outcomes

1. Learning the basics of chemical kinetics
2. Understanding the basics of catalysis and adsorption
3. Introduced to the fundamentals of photochemistry
4. Learning the basics of computational chemistry
5. Learning the fundamentals of electrochemical cells

Semester	Subject Title	Total Hours	Credit
VI	**PHYSICAL CHEMISTRY- II**	75	5

UNIT I: CHEMICAL KINETICS (20hrs)

Rate of reaction- Average and instantaneous rates, factors influencing rate of reaction - molecularity of a reaction - rate equation - order and molecularity, Rate laws - Rate constants - derivation of rate constants and characteristics for zero, first, second and third order (equal initial concentration) - Derivation of time for half change. Methods of determination of order of reactions - Experimental methods of determination of rate constant of a reaction - Volumetry, manometry and polarimetry.

Effect of temperature on reaction rate - temperature coefficient - concept of activation energy - energy barrier - Arrhenius equation. Theories of reaction rates - Collision theory - derivation of rate constant of bimolecular gaseous reaction - Failure of collision theory. Theory of absolute reaction rates - Derivation of rate constant for a bimolecular reaction - significance of entropy and free energy of activation. Comparison of collision theory and ARRT.

UNIT II: CATALYSIS AND ADSORPTION (15 hrs)

Catalysis - general characteristics of catalytic reactions, auto catalysis, promoters, negative catalysis, poisoning of a catalyst - theories of homogenous and heterogenous catalysis - Kinetics of Acid - base and enzyme catalysis- Mechanism (lock and key, induced fit), Michaelis-Menton equation (no derivation) - Heterogenouscatalysis

Adsorption - Difference between absorption and adsorption - Chemical and physical adsorption and their general characteristics- distinction between them Different types of isotherms - Freundlich and Langmuir. Adsorption isotherms and their limitations - BET theory (no derivation)

UNITIII: PHOTOCHEMISTRY (10 hrs)

Photo physical processes - Jablonski diagram - Laws of photo chemistry - Lambert - Beer, Grotthus- Draper and Stark –Einstein. Quantum efficiency. Fluorescence and Phosphorescence. Photo chemical reactions - rate law - Kinetics of H_2-Cl_2 and H_2-I_2 reactions, comparison between thermal and photochemical reactions.

UNIT IV: GROUPTHEORY and COMPUTATIONAL CHEMISTRY (10 hrs)

Symmetry elements and symmetry operation symmetry operation of H_2O molecule, Illustration of mathematical rules for the group using symmetry operations of H_2O

molecule. Construction of multiplication table, for H_2O molecule. Point group - Definition Elements (symmetry operations) of the following point groups C_n (C_2, C_3), C_{nv} (C_{2V}, C_{3V}) and C_{nh}(C_{2h}, C_{3h})

Introduction to computational chemistry – Optimization of structure – Z-matrix, Use of software for computing structures - eg. Avogadro

UNIT V: ELECTROCHEMICAL CELLS (20 hrs)

Electrolytic & Galvanic cells - Reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement computation of E.M.F. calculation of thermodynamic quantities of cell reactions (ΔG,ΔH, ΔS and K_{eq}).Application of Gibbs Helmholtz equation. Calculation of E.M.F. Types of reversible electrodes - Gas/metal ion- metal/metal ion; metal/insoluble salt/anion and Redox electrodes. Electrode reactions - Nernst equation - Derivation of cell E.M.F. and single electrode potential - standard hydrogen electrode - reference electrodes (Calomel electrode)- standard electrodes reduction potentials – sign convention - Electrochemical series and its significance. Concentration cell with and without transport. Liquid junction potential. Application of EMF concentration cells. Valency of ion, solubility product and activity co-efficient. Potentiometrictitrations. Determination of pH using Hydrogen, quinhydrone and glass electrodes. Determination of pK_a of acids by potentiometric method. Fuel cells - Corrosion - general and electrochemical theory - passivity - prevention of corrosion.

TEXT BOOKS

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th ed., Vishal Publishing Company,2016.
2. Sharma K.K. and Sharma L.K., A Text Book of Physical Chemistry, 6th ed., S Chand,2016.
3. Group Theory In Chemistry: Bonding and Molecular Spectroscopy, Asok K Mukherjee, Bankim Chandra Ghosh, Universities Press Private Limited, Chennai,2018
4. Problems and Solutions: Physical Chemistry, C Kalidas and M V Sangaranarayanan, Universities Press Private Limited, Chennai,2020
5. Simple Approach to Group Theory in Chemistry, A, S Swarnalakshmi;T Saroja;R M Ezhilarasi, Universities Press Private Limited, Chennai,2008
6. Chemical and Electrochemical Energy Systems, R Narayan;B Viswanathan, Universities Press Private Limited, Chennai,1998

Books for References

1. Maron S.H. and Lando J.B. Fundamentals of Physical Chemistry, Macmillan.
2. Glasstone S. and Lewis. D., Elements of Physical Chemistry, Macmillan
3. Kheterpal S.C. Pradeep Physical Chemistry, Volume I &II, Pradeep Publications Jalandhur, 2004.
4. Jain D.V.S. and Jainhar S.P., Physical Chemistry, Principles and Problems, Tata McGraw Hill, New Delhi,1988.
5. Bajpai D.N., Advanced Physical Chemistry, S Chand Publishing,2001.
6. Negi A.S. and Anand S.C., A Textbook of Physical Chemistry, John Wiley & Sons Pvt. Ltd.,1986.