DEPT. OF CHEMISTRY

LIST OF NEW COURSES

Sl.No	Sub Code	NAME OF THE SUBJECT	Credits			
1	19CH1001	Engineering Chemistry For Electrical Engineers	3	0	0	3
2	19CH1002	Chemistry For Computer Science and Engineering	2	0	0	2
3	19CH1003	Engineering Chemistry for Mechanical Engineering	3	0	0	3
4	19CH1004	Engineering Chemistry for Aerospace Engineering	3	0	0	3
5	19CH1005	Chemistry for Electronics and Communication Engineering	2	0	0	2
6	19CH1006	Applied Chemistry for Civil Engineering	3	0	0	3
7	19CH1007	Applied Chemistry Laboratory	0	0	2	1
8	19CH1008	Applied Chemistry for Instrumentation Engineering	3	0	0	3
9	19CH3001	Composite Materials	3	0	0	3
10	19CH3002	Waste to Energy	3	0	0	3

19CH1001	Engineering Chemistry For Electrical Engineers	L	T	P	C
		3	0	0	3

Course Objectives:

Enable the student

1. To make the student conversant with the fundamentals of chemical bonding and nanotechnology
2. To encourage students to develop curiosity towards fuels, energy resources and storage devices
3. To acquire knowledge about nanomaterials and surface chemistry

Course Outcomes:

The Student will be able to

1. formulate electronic structures and correlate its properties
2. relate the unique properties of nanomaterials and explain methods of fabricating nanostructures
3. describe the various energy sources
4. learn the various energy storage systems and conversion devices
5. describe the techniques involved in adsorption and colloids
6. realize the applications of the liquid crystals in various domains

Module 1: Chemical Bonding (9 Hours)

Types of bonding – Ionic, Covalent, Coordinate bond, Vanderwaals forces, Hydrogen bond, Metallic bond VB theory – Hybridization - MO theory, bond order- Homonuclear and heteronuclear diatomic molecules

Module 2: Nanomaterials and Fabrication (6 Hours)

Nanomaterials –Classification - Top down and Bottom up Approaches - High energy Ball milling – microfabrication – CVD, sol-gel – Nanomaterials - Fullerenes – Self assembled monolayers –preparation and application - characterization of nanomaterials – Introduction to XRD, SEM -Applications of nanotechnology

Module 3: Electrochemistry & Corrosion (9 Hours)

Redox reactoions – electrode potential - Nernst Equation - Electrochemical series and significance - Electrochemical cell, Corrosion – Dry and Wet Corrosion - Factors Influencing corrosion - Prevention of Corrosion – Galvanic, sacrificial anodic protection.

Module 4: Energy sources and storage devices (9 Hours)

Batteries – Primary cell (Dry batteries), Secondary Cell (lead acid batteries) H_2O_2 - Fuel cell – Microbial Fuel cell - Electrochemical sensors - Photovoltaics

Module 5: Liquid Crystals (6 Hours)

Liquid crystals –classification, thermotropic and Lyotropic liquid crystals, structure of liquid crystal forming compounds, Chemical properties, Applications of liquid crystals.

Module 6: Surface chemistry (6 Hours)

Adsorption- Classification, uses - Langmuir's theory of adsorption - Colloids – types, applications - Colloids – Preparation - Characteristics of Colloids, Micelles.

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980.
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.
3. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007.

19CH1002	Chemistry For Computer Science And Engineering	L	T	P	C
		2	0	0	2

Course Objectives:

Enable the student to

1. Understand the fundamentals of chemical bonding, polymers and nanotechnology.
2. Recognize the significance of electrochemical reactions and energy storage devices.
3. Infer the modern techniques related to liquid crystals and spectroscopy techniques.

Course Outcomes:

The students will be able to

1. Describe the basic principles of chemical structures and its bonding characteristics.
2. Identify the various types of polymers and its functionalities.
3. Interpret the characteristics of nanomaterials and its applications.
4. Explain the principles of electrochemical reactions and storage devices.
5. Relate the applications of the liquid crystals in various domains
6. Describe the spectroscopic techniques and its related applications

Module 1: Chemical Bonding (5 Hours)

Types of bonding – Ionic, Covalent, Coordinate bond, Vander Waals forces, Hydrogen bond, Metallic bond, VB theory – Hybridization, MO theory.

Module 2: Polymers (5 Hours)

Polymers – Functionality - Tacticity of polymers - Classification – natural, synthetic – thermosetting plastics and thermoplastics- ingredients used in compounding of plastics-Applications of polymers.

Module 3: Nanomaterials (5 Hours)

Nanomaterials –Classification - Top down and Bottom up Approaches - High energy Ball milling – Microfabrication – CVD - Fullerenes – Self assembled monolayers – Applications of Nanotechnology

Module 4: Electrochemical Reactions and Energy Storage Devices (5 Hours)

Redox reactions – Electrode potential-Nernst Equation - Electrochemical series - Electrochemical cell. Primary batteries: Dry cell; Advanced Primary batteries - Lithium batteries - secondary batteries: Lead-acid, Fuel cells: Hydrogen-oxygen fuel cells

Module 5: Liquid Crystals (5 Hours)

Liquid crystals – Classification, thermotropic and Lyotropic liquid crystals, Structure of liquid crystal forming compounds, Chemical properties, Applications of liquid crystals

Module 6: Spectroscopic Techniques (5 Hours)

Electromagnetic radiation, relation between wave length, wave number, frequency and energy–Principles and applications of IR and UV-Visible spectroscopy.

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. M. J. Sienko and R. A. Plane, "Chemistry: Principles and Applications",3rd Edition, McGraw Hill, 1980, ISBN-10: 0070573212, ISBN-13: 978-0070573215.
2. B. L. Tembe, Kamaluddin and M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)".
3. P. W. Atkins, Julio de Paula, "Physical Chemistry", 8th Edition, Oxford University press, 2007.
4. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw-Hill publishing, 2010.

19CH1003	Engineering Chemistry for Mechanical Engineering	L	T	P	C
		3	0	0	3

Course Objectives

Enable the student to

1. To understand the basic concepts in chemistry
2. To have knowledge on the applications of Chemistry
3. To apply chemistry principles in Engineering and Technology

Course Outcomes

The student will be able to

1. Formulate electronic structures and correlate its properties
2. Learn the various factors in water quality and its technology
3. Realize the potential applications of polymers
4. Analyze the combustion process of common fuels
5. Learn the various energy storage systems and conversion devices
6. Apply the instrumental methods for various types of analysis

Module 1: Chemical bonding (8L)

Types of bonding – Ionic, Covalent, Coordinate bond, Vander Waalss forces, Hydrogen bond, Metallic bond VB theory – Hybridization MO theory, bond order- Homonuclear and Hetronuclear diatomic molecules

Module 2: Water Chemistry (8L)

Hardness, Units and calculation of hardness - Determination of hardness by EDTA method - Removal of hardness – Zeolite process - Ion – Exchange process, sludge – formation and disadvantages - Scale - sources and disadvantages Internal conditioning – Calgon & carbonate conditioning - Boiler corrosion – causes (DO, CO_2, acids) & removal methods - Desalination – Reverse Osmosis .

Module 3: Polymers (8L)

Polymers – Introduction, functionality, tacticity of polymers, Classification – natural, synthetic - Addition polymer, condensation polymer, copolymer- thermosetting plastics, thermoplastics- ingredients used in compounding of plastics- compression and injection molding, fiber reinforced plastics- preparation, properties and uses of polyethylene, polyvinyl chloride, Bakelite, epoxy resin, raw rubber – vulcanized rubber – Applications of polymers – conducting polymers

Module 4: Fuels and combustion (7L)

Fuels-classification, calorific value, Dulong's formula - desired properties of good coal - Proximate analysis of coal and its significance- Ultimate analysis of coal and its significance -Knocking-octane number, cetane number, antiknocking characteristics of petrol -Flue Gas Analysis by Orsat Method –Rocket Propellents

Module 5: Energy sources and storage devices (7L)

Redox reactions – electrode potential - Nernst Equation - Electrochemical series and significance - Electrochemical cell, reference electrode - Batteries – dry cell -Lead acid battery - Fuel cell - Solar battery- Electrochemical sensors.

Module 6: Instrumental Methods (7L)

Electromagnetic radiation, relation between wave length, wave number, frequency and energy- General features of absorption photometer – Principles and applications of IR, UV-Visible spectroscopy, - Flame photometer – Introduction to Atomic Absorption Spectroscopy

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980.
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.
3. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007.
4. Fundamentals of Molecular Spectroscopy, by C. N. Banwell, 4th Edition, Tata McGraw-Hill India Ltd, 2010.

19CH1004	Engineering Chemistry for Aerospace Engineering	L	T	P	C
		3	0	0	3

Course Objectives

Enable the students

1. To understand the basic concepts in chemistry
2. To have knowledge on the applications of Chemistry
3. To apply chemistry principles in Engineering and Technology

Course Outcomes

The student will be able to

1. formulate electronic structures and correlate its properties
2. learn the various factors in water quality and its technology
3. realize the potential applications of polymers
4. analyze the combustion process of common fuels
5. learn the various energy storage systems and their corrosion behaviour
6. Apply the instrumental methods for various types of analysis

Module 1: Chemical bonding (7L)

Types of bonding – Ionic, Covalent, Coordinate bond, Vander Waals forces, Hydrogen bond, Metallic bond VB theory – Hybridization MO theory, bond order- Homonuclear and Heteronuclear diatomic molecules

Module 2: Water Chemistry (8L)

Hardness, Units and calculation of hardness - Determination of hardness by EDTA method - Removal of hardness – Zeolite process - Ion – Exchange process, sludge – formation and disadvantages - Scale - sources and disadvantages Internal conditioning – Calgon & carbonate conditioning - Boiler corrosion – causes (DO, CO_2, acids) & removal methods - Desalination – Reverse Osmosis .

Module 3: Polymers (7L)

Polymers – Introduction, functionality, tacticity of polymers, Classification – natural, synthetic - Addition polymer, condensation polymer, copolymer- thermosetting plastics, thermoplastics- ingredients used in compounding of plastics- compression and injection molding, fiber reinforced plastics- preparation, properties and uses of polyethylene, polyvinyl chloride, Bakelite, epoxy resin, raw rubber – vulcanized rubber – Applications of polymers

Module 4: Fuels and combustion (7L)

Fuels-classification, calorific value, Dulong's formula - desired properties of good coal - Proximate analysis of coal and its significance- Ultimate analysis of coal and its significance -Knocking-octane number, cetane number, antiknocking characteristics of petrol -Flue Gas Analysis by Orsat Method –Rocket Propellants

Module 5: Electrochemical systems and corrosion (10L)

Redox reactions – electrode potential - Nernst Equation - Electrochemical series and significance - Electrochemical cell, reference electrode - Batteries – dry cell -Lead acid battery - Fuel cell – Corrosion-definition; types – Oxidation corrosion, corrosion by other gases and liquid metal corrosion; Electrochemical corrosion – mechanism and types only; Factors affecting corrosion and corrosion control methods-.

Module 6: Instrumental Methods (6L)
Electromagnetic radiation, relation between wave length, wave number, frequency and energy- General features of absorption photometer – Principles and applications of IR, UV-Visible - Spectroscopy

Text Books:
1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:
1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007
4. Fundamentals of Molecular Spectroscopy, by C. N. Banwell, 4th Edition, Tata McGraw-Hill India Ltd, 2010

19CH1005	Chemistry for Electronics and Communication Engineering	L	T	P	C
		2	0	0	2

Course Objectives:
Enable the student to
1. Understand the fundamentals of chemical bonding, polymers and nanotechnology.
2. Recognize the significance of electrochemical reactions and energy storage devices.
3. Infer the modern techniques related to liquid crystals and spectroscopy techniques.

Course Outcomes:
The students will be able to
1. Describe the basic principles of chemical structures and its bonding characteristics.
2. Identify the various types of polymers and its functionalities.
3. Interpret the characteristics of nanomaterials and its applications.
4. Explain the principles of electrochemical reactions and storage devices.
5. Relate the applications of the liquid crystals in various domains
6. Describe the spectroscopic techniques and its related applications

Module 1: Chemical Bonding (5 Hours)
Types of bonding – Ionic, Covalent, Coordinate bond, Vander Waals forces, Hydrogen bond, Metallic bond, VB theory – Hybridization, MO theory.

Module 2: Polymers (5 Hours)
Polymers – Functionality - Tacticity of polymers - Classification – natural, synthetic – thermosetting plastics and thermoplastics- ingredients used in compounding of plastics-Applications of polymers.

Module 3: Nanomaterials (5 Hours)
Nanomaterials –Classification - Top down and Bottom up Approaches - High energy Ball milling – microfabrication – CVD - Fullerenes – Self assembled monolayers – Applications of Nanotechnology

Module 4: Electrochemical Reactions and Energy Storage Devices (5 Hours)
Redox reactions – electrode potential-Nernst Equation - Electrochemical series - Electrochemical cell. Primary batteries: Dry cell; Advanced Primary batteries - Lithium batteries - secondary batteries: Lead-acid, Fuel cells: Hydrogen-oxygen fuel cells

Module 5: Liquid Crystals (5 Hours)
Liquid crystals –classification, thermotropic and Lyotropic liquid crystals, structure of liquid crystal forming compounds, Chemical properties, Applications of liquid crystals

Module 6: Spectroscopic Techniques (5 Hours)
Electromagnetic radiation, relation between wave length, wave number, frequency and energy–Principles and applications of IR and UV-Visible spectroscopy.

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. M. J. Sienko and R. A. Plane, "Chemistry: Principles and Applications", 3rd Edition, McGraw Hill, 1980, ISBN-10: 0070573212, ISBN-13: 978-0070573215.
2. B. L. Tembe, Kamaluddin and M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)".
3. P. W. Atkins, Julio de Paula, "Physical Chemistry", 8th Edition, Oxford University press, 2007.
4. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw-Hill publishing, 2010.

19CH1006	Applied Chemistry for Civil Engineering	L	T	P	C
		3	0	0	3

Course Objectives

Enable the students

1. To encourage students to develop curiosity towards water technology, corrosion and nanocomposites
2. To make the student conversant with the fundamentals of Corrosion and corrosion control
3. To acquire knowledge about polymers, concrete.

Course Outcome

Students will be able to

1. understand the various factors in water quality
2. learn the various water purification process and their applications
3. describe the process of corrosion
4. identify the methods to control corrosion
5. analyze the components present in cement and concrete
6. realize the potential applications of polymers

Module 1 Water Technology - I (9L)

Sources of water – Impurities in water - Hardness, Units and calculation of hardness – Determination of hardness by EDTA method -Disadvantages of water – Scales – Sludges – Internal conditioning – Calgon & carbonate conditioning In Caustic embrittlement – Bioiler corrosion - – causes (DO, CO_2, acids) & removal methods – Alkalanity – Calculation of alkalinity – Determination of dissolved oxygen

Module 2 Water Technology - II (6L)

Removal of hardness – Zeolite process - Ion – Exchange process, Municipal water treatment methods – Purification of water for domestic use - Desalination – Electrodialysis - Reverse Osmosis -

Module 3 Corrosion (6L)

Dry Corrosion – Oxidation corrosion – mechanism – Wet corrosion – Mechanism – Galvanic corrosion – Galvanic series – Factors influencing corrosion

Module 4 Corrosion control (7L)

Corrosion control methods - Organic coatings – Paints - constituents of Paints Analysis of oils-acid value, Saponification value, Iodine value, Reichert-Meissl value, Formulation of paints, Failure of a paint film – Varnishes – Emulsion Paints

Module 5 Cement and concrete (8L)

Cement – Introduction – classification, Portland cement – Manufacture – Properties, Chemical composition of cement -Setting and Hardening of Portland cement –-. Special cements - Concrete –Uses – Curing of concrete, Reinforced concrete construction (RCC), Decay of concrete, Protection of concrete.

Module 6 Polymers (9L)

Polymers – Introduction, functionality, tacticity of polymers, Classification – natural, synthetic - Addition polymer, condensation polymer, copolymer- Forces between polymeric chains – thermosetting plastics, thermoplastics- ingredients used in compounding of plastics- compression & injection moulding, fiber

reinforced plastics- preparation, properties and uses of polyethylene, polyvinyl chloride, bakelite, epoxy resin, raw rubber – vulcanized rubber – Applications of polymers – conducting polymers

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Ed., McGraw Hill, 1980
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Ed, Oxford University Press, 2001
4. Advanced Inorganic Chemistry Sathya Prakash, G.D.Tuli, R.D.Madan, S.K.Basu, S. Chand & Company, 2016
5. Principles of Physical Chemistry – Puri, Sharma and Pathania, Vishal Publishing & Co.

19CH1007	Applied Chemistry Laboratory	L	T	P	C
		0	0	2	1

List of Experiments:

1. Estimation of alkalinity in water sample.
2. Estimation of total, permanent and temporary hardness by EDTA method in water sample.
3. Estimation of copper in brass
4. Estimation of calcium in milk powder
5. Determination of dissolved oxygen in water sample.
6. Estimation of iodine content in iodized common salt
7. Conductometric estimation of an acid
8. Estimation of acid using pH measurements
9. Potentiometric estimation of Fe^{2+} ions
10. Estimation of iron in water sample by spectrophotometry
11. Preparation of aspirin
12. Synthesis of cadmium sulfide nanocrystals

Text Books

1. Mendhem J., Denny R. C., Barnes J. D., Thomas M. J. K., Vogel's Quantitative Chemical Analysis, Pearson Education limited, 6th Edition, 2000.
2. Elias, A. J., A Collection of Interesting General Chemistry Experiments, Revised Edition, Universities Press, 2007.

19CH1008	Applied Chemistry for Instrumentation Engineering	L	T	P	C
		3	0	0	3

Course Objectives:

Enable the student to

1. Understand the fundamentals of chemical bonding, polymers and nanotechnology.
2. Recognize the significance of electrochemical reactions and energy storage devices.
3. Infer the advancements in crystallography and spectroscopy techniques.

Course Outcomes:

The students will be able to

1. Describe the basic principles of chemical structures and its bonding characteristics.
2. Identify the various types of polymers and its functionalities.
3. Interpret the characteristics of nanomaterials and its applications.
4. Explain the principles of electrochemical reactions and storage devices.
5. Relate the applications of the crystallography in various domains

6. Describe the spectroscopic techniques and its related applications

Module 1:Chemical Bonding: (8 Hours)

Types of bonding – Ionic, Covalent, Coordinate bond, Vander Waals forces, Hydrogen bond, Metallic bond, VB theory – Hybridization, MO theory.

Module 2: Polymers (7 Hours)

Polymers – Functionality - Tactility of polymers – Classification – natural, synthetic – Thermosetting plastics and thermoplastics- Ingredients used in compounding of plastics -polyurethane -Applications of polymers in medical field.

Module 3: Nanomaterials (7 Hours)

Nanomaterials –Classification - Top down and Bottom up Approaches - High energy Ball milling – microfabrication – CVD - Fullerenes – Self assembled monolayers – Applications of Nanotechnology

Module 4: Electrochemical Reactions and Energy Storage Devices (8 Hours)

Redox reactions – electrode potential-Nernst Equation - Electrochemical series - Electrochemical cell. Primary batteries: Dry cell; Advanced Primary batteries - Lithium batteries - secondary batteries: Lead-acid, Fuel cells: Hydrogen-oxygen fuel cells

Module 5: Crystallography (7 Hours)

Amorphous and Crystalline Solids- Crystal Structure - crystal lattice, x-ray diffraction, Bragg's law, Experimental determination of crystal structure – Crystal imperfections

Module 6: Spectroscopic Techniques (8 Hours)

Electromagnetic spectrum - Relation between wave length, wave number, frequency and energy–Types of Energy -Principles and applications of IR and UV-Visible spectroscopy.

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. M. J. Sienko and R. A. Plane, "Chemistry: Principles and Applications", 3rd Edition, McGraw Hill, 1980, ISBN-10: 0070573212, ISBN-13: 978-0070573215.
2. B. L. Tembe, Kamaluddin and M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)".
3. P. W. Atkins, Julio de Paula, "Physical Chemistry", 8th Edition, Oxford University press, 2007.
4. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw-Hill publishing, 2010.

19CH3001 COMPOSITE MATERIALS

Credits: 3:0:0:3

Course objectives

Enable the student to

1. Understand the importance of composites
2. Know about different types of composite materials
3. Learn various mechanical characterization techniques

Course outcome

Students will be able to

1. Obtain basic knowledge about composite materials
2. Expand their understanding on reinforcement mechanism and mechanical properties
3. Gain more information on metal matrix composite materials
4. Understand thoroughly about polymer matrix composite materials
5. Recognize the influence of nanofillers on mechanical properties polymer matrix composite materials
6. Comprehend more on ceramic matrix composite materials

Module I. Introduction

Introduction to composite material – Definition and classification and characteristics of composites – metal-matrix, polymer, ceramic and carbon-carbon composites – Advantages and applications of composites – Reinforcement - particle filled, short and long fibre reinforced; laminates

Module II. Types of reinforcements

Interface interaction – filler-matrix interaction – Effect of size, shape, distribution, volume fraction on overall performance of composites – 2D reinforcement – layup method; Long or short fibre reinforcement - properties and applications of glass fibres, carbon fibres, Kevlar fibres and boron fibres; Particulate reinforcement – whiskers and various particulate fillers; Mechanical behaviour of polymers – rule of mixtures, inverse rule of mixtures.

Module III. Fabrication of polymer matrix composites

Fabrication of polymer composites - Compounding of plastics – additives added and their significance – moulding processes – injection and compression moulding, lamination, hand lay-up, autoclave technique and filament winding techniques; Polymer nanocomposites - introduction; advantages and limitations of nanofillers; surface functionalization of nanofillers; properties and application of polymer composites.

Module IV. Fabrication of metal matrix composites

Casting – solid state diffusion technique, hot isostatic pressing; properties and applications of metal matrix composites;

Module V. Fabrication of ceramic matrix composites

Fabrication of ceramic matrix composites – liquid metal infiltration, liquid phase sintering; properties and applications of ceramic matrix composites; Fabrication of carbon-carbon composites – influence of knitting, braiding, weaving of carbon fabric – properties and applications of carbon-carbon composites

Module VI. Mechanical characterization of polymer composites

Mechanical behaviour of polymers – Testing of tensile, compressive, impact and fracture strength; Hardness test, Fatigue and creep testing –

Reference Books:

1. K K Chawla, "Composite Materials", Springer, 2012
2. R. Balasubramaniam, (adapted) "Materials Science and Engineering, An Introduction by W D Callister", John Wiley and Sons, NY Indian Edition (2007)
3. R. J. Yound and P. A. Lovell, "Introduction to Polymers", Stanley Thomas Publishers, London, 2000.
4. Y. W. Mai and Z. Z. Yu, "Polymer Nanocomposites", Woodhead Publishing Ltd., Cambridge, England, 2006.
5. P. Ma, N. A. Siddiqui, G. Marom and J. Kim, "Dispersion and Functionalisation of Carbon Nanotubes for Polymer based Nanocomposites: a review", Composites: Part A vol. 41 pp 1345-1367, 2010.

19CH3002 WASTE TO ENERGY

Credits: 3:0:0:3

Course Objectives:

To impart knowledge on

1. Types of waste materials
2. Conversion processes to convert waste to energy.
3. Biomass, Biogas and Biodiesel.

Course Outcomes:

The students will able to

1. Understand the concept of waste to energy conversion, based on its properties
2. Select the conditions for biomass pyrolysis.
3. Develop a small size biomass gasifier.
4. Prepare biodiesel and analyze its performance.

5. Understand the current research scenario in waste to energy application
6. Design a community biogas plant.

Module 1: Introduction to Energy from Waste: (7L + 1T)

Classification of waste as fuel – Solid waste Management - Agro based, Forest residue, Industrial waste – Municipal solid waste – Conversion devices – Incinerators, gasifiers, digesters.

Module 2: Catalysis in waste conversion: (5L + 1T)

Catalysts - Preparation of heterogeneous nano based catalyst – Properties – Application in the field of Energy.

Module 3: Biodiesel production (6L + 2T)

Waste vegetable oil and animal fat characteristics – fatty acid composition – oil extraction – oil refining process – Transesterification – ASTM characterization – Application.

Module 4: Biogas Production. (5L + 1T)

Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Types of biogas Plants – Applications - Alcohol production from biomass.

Module 5: Biomass Pyrolysis: (7L + 2T)

Pyrolysis – pyrolysis process based on heating rate – Types, slow fast – Application - Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module 6: Biomass Gasification: (7L + 1T)

Types of gasification reaction – Types Gasifiers – Fixed bed system –Fluidized bed gasifiers - Downdraft and updraft gasifiers – Design, construction and operation – Application - Bench mark performance parameter.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
5. Introduction to Biomass Energy Conversions, Sergio C. Capareda, CRC press, Taylon & Francis, 2014.
6. Non Conventional Energy Resources, G.D. Rai, 8th reprint, Khanna Publisher, 2013.
7. Biogas system: Principles and Application, K.M. Mital, 1st Edition, New Age International private Ltd., New Delhi, 2012.

CHEMISTRY

LIST OF COURSES

Sl.No	Sub Code	NAME OF THE SUBJECT	Credits L:T;P:C
1	18CH1001	Chemistry-I	3:1:0:4
2	18CH1002	Applied Chemistry Laboratory	0:0:3:1.5
3	18CH1003	Engineering Chemistry	3:1:0:4
4	18CH1004	Chemistry for Computer Science and Engineering	3:1:0:4
5	18CH1005	Chemistry for Civil Engineering	3:1:0:4
6	18CH1006	Applied Chemistry	3:1:0:4
7	18CH2001	Environmental Studies	3:0:0:3
8	18CH2002	Chemical Applications	3:0:0:3
9	18CH2003	Polymer Chemistry	3:0:0:3
10	18CH2004	Experiments in Polymer Chemistry	0:0:4:2
11	18CH3001	Research Methodology and IPR	3:0:0:3
12	18CH3002	Tribology of Polymer Composites	3:0:0:3
13	18CH3003	Laboratory Chemistry for the Daily Life	0:0:4:2
14	18CH3004	Polymer Chemistry	3:0:0:3

18CH1001	Chemistry-I	L	T	P	C
		3	1	0	4

Course Objectives:

1. To understand the basic concepts in chemistry
2. To have knowledge on the applications of chemistry
3. To apply chemistry principles in engineering and technology

Course Outcomes:

The student will be able to

1. To study about the basics of atomic and molecular structure
2. To know about the spectroscopic techniques and its applications
3. To know about the periodic properties
4. To understand the concepts of intermolecular forces
5. To study the concept of free energy and chemical equilibrium
6. To understand the basics of organic chemistry

Module 1: Chemical Bonding (9L + 3T)

Types of bonding – Ionic, Covalent, Coordinate bond, Vanderwaals forces, Hydrogen bond, Metallic bond VB theory – Hybridization MO theory, bond order-Homonuclear and Hetronuclear diatomic molecules

Module 2: Spectroscopic techniques and applications (9L + 3T)

Electromagnetic radiation, relation between wave length, wave number, frequency and energy- General features of absorption photometer – Principles and applications of IR, Raman, UV-Visible, NMR spectroscopy - Flame photometer – Introduction to Atomic Absorption Spectroscopy –Types of Chromatography –Applications

Module 3: Fuels and combustion (6L +2T)

Fuels-classification, calorific value, desired properties of good coal - Dulong's formula -Proximate analysis of coal and its significance- Ultimate analysis of coal and its significance -Knocking-octane number, cetane number, antiknocking characteristics of petrol -Flue Gas Analysis – Orsat Method - Biomass - Biogas-production, biofuels- bio-diesel and bio-ethanol

Module 4: Energy sources and storage devices (9L + 3T)

Redox reactoions – electrode potential - Nernst Equation - Electrochemical series and significance - Electrochemical cell, reference electrode - Batteries – dry cell -Lead acid battery - Fuel cell - Solar

battery- Electrochemical sensors -Relationship between electrical energy and heat energy – Gibbs Helmoltz equation, Photovoltoics

Module 5: Water Chemistry (6L + 2T)

Hardness, Units and calculation of hardness - Determination of hardness by EDTA method - Removal of hardness – Zeolite process - Ion – Exchange process, sludge – formation and disadvantages - Scale - sources and disadvantages Internal conditioning – Calgon & carbonate conditioning - Boiler corrosion – causes (DO, CO_2, acids) & removal methods - Desalination – Reverse Osmosis - Municipal water treatment methods.

Module 6: Reaction Mechanism (6L + 2T)

Introduction- Homolytic and heterolytic bond fission- Classification of reactions- Types of Attacking Reagents- Inductive effect- Electromeric effect- Resonance effect- Hyperconjucation- Effect of Hybridization- types of Addition reaction- Types of Substitution reaction- Types of Elimination reaction- Mechanism of elimination reaction- Mechanism of Nucleophilic substitution reaction- Steric hindrance

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980
2. Fundamentals of Molecular Spectroscopy, by C. N. Banwell, 4th Edition, Tata McGraw-Hill India Ltd, 2010
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
4. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University pres, 2007
5. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition, Freeman and Company, New York, 2007

18CH1002	APPLIED CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1. To understand the basic concepts in chemistry
2. To have knowledge on the applications of chemistry
3. To apply chemistry princples in engineering and Technology

Course Outcomes:

The students will be able to:

1. Understand the kinetics of a chemical reaction
2. analyse the water quality
3. apply the electrochemistry principles
4. measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials
5. synthesize a small drug molecule
6. analyse a salt sample

List of Experiments

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression

6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Textbooks:

1. *H. D. Crockford*, J.W. Nowell, *Laboratory Manual of Physical Chemistry*, 8th Edition, Wiley, 1970.
2. An Introduction to Practical Biochemistry, third edition by David T Plummer, McGraw-Hill, c. McGraw-Hill Book Company (U.K.) Ltd., London. 1987

18CH1003	ENGINEERING CHEMISTRY	L	T	P	C
		3	1	0	4

Course Objectives:

1. To make the student conversant with the fundamentals of chemical bonding and nanotechnology
2. To encourage students to develop curiosity towards fuels, energy resources and storage devices
3. To acquire knowledge about polymers and surface chemistry

Course Outcomes:

The Student will be able to

1. formulate electronic structures and correlate its properties
2. realize the potential applications of polymers
3. relate the unique properties of nanomaterials and explain methods of fabricating nanostructures
4. analyze the *combustion* process of common *fuels*
5. learn the various energy storage systems and conversion devices
6. describe the techniques involved in adsorption and colloids

Module 1: Chemical Bonding (9L + 3T)

Types of bonding – Ionic, Covalent, Coordinate bond, Vanderwaals forces, Hydrogen bond, Metallic bond VB theory – Hybridization MO theory, bond order- Homonuclear and Hetronuclear diatomic molecules

Module 2: Polymers (9L + 3T)

Polymers – Introduction, functionality, tacticity of polymers, Classification – natural, synthetic - Addition polymer, condensation polymer, copolymer- Forces between polymeric chains – thermosetting plastics, thermoplastics- ingredients used in compounding of plastics- compression & injection molding, fiber reinforced plastics- preparation, properties and uses of polyethylene, polyvinyl chloride, Bakelite, epoxy resin, raw rubber – vulcanized rubber – Applications of polymers – conducting polymers

Module 3: Nanomaterials and Fabrication (6L +2T)

Nanomaterials –Classification - Top down and Bottom up Approaches - High energy Ball milling – microfabrication – CVD, sol-gel – Nanomaterials - Fullerenes – Self assembled monolayers –preparation and application - characterization of nanomaterials – Introduction to XRD, SEM -Applications of nanotechnology

Module 4: Fuels and combustion (6L +2T)
Fuels-classification, calorific value, desired properties of good coal - Dulong's formula -Proximate analysis of coal and its significance- Ultimate analysis of coal and its significance -Knocking-octane number, cetane number, antiknocking characteristics of petrol -Flue Gas Analysis – Orsat Method - Biomass - Biogas-production, biofuels- bio-diesel and bio-ethanol

Module 5: Energy sources and storage devices (9L + 3T)
Redox reactions – electrode potential - Nernst Equation - Electrochemical series and significance - Electrochemical cell, reference electrode - Batteries – dry cell -Lead acid battery - Fuel cell - Solar battery- Electrochemical sensors -Relationship between electrical energy and heat energy – Gibbs Helmholtz equation, Photovoltoics

Module 6: Surface chemistry (6L +2T)
Adsorption- Classification, uses - Langmuir's theory of adsorption - Colloids – types, applications - Colloids – Preparation - Characteristics of Colloids, Micelles

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007

18CH1004	CHEMISTRY FOR COMPUTER SCIENCE AND ENGINEERING	L	T	P	C
		3	1	0	4

Course objectives
1. To make the student conversant with the fundamentals of chemical bonding and nanotechnology
2. To encourage students to develop curiosity towards energy resources and storage devices
3. To acquire knowledge about solid state and liquid crystals

Course outcome
The Students will be able to
1. formulate electronic structures and correlate its properties
2. realize the potential applications of polymers
3. relate the unique properties of nanomaterials and explain methods of fabricating nanostructures
4. know about various energy storage devices
5. learn the importance of solid state chemistry
6. realize the applications of the liquid crystals in various domains

Module 1: Chemical Bonding (9L + 3T)
Types of bonding – Ionic, Covalent, Coordinate bond, Vanderwaals forces, Hydrogen bond, Metallic bond VB theory – Hybridization MO theory, bond order- Homonuclear and Hetronuclear diatomic molecules

Module 2: Polymers (9L + 3T)
Polymers – Introduction, functionality, tacticity of polymers, Classification – natural, synthetic - Addition polymer, condensation polymer, copolymer- Forces between polymeric chains – thermosetting plastics, thermoplastics- ingredients used in compounding of plastics- compression & injection molding, fiber reinforced plastics- preparation, properties and uses of polyethylene, polyvinyl chloride, Bakelite, epoxy resin, raw rubber – vulcanized rubber – Applications of polymers – conducting polymers

Module 3: Nanomaterials and Fabrication (6L +2T) Nanomaterials –Classification - Top down and Bottom up Approaches - High energy Ball milling – microfabrication – CVD, sol-gel – Nanomaterials -

Fullerenes – Self assembled monolayers –preparation and application - characterization of nanomaterials – Introduction to XRD, SEM -Applications of nanotechnology

Module 4: Energy sources and storage devices (9L + 3T)

Redox reactions – electrode potential - Nernst Equation - Electrochemical series and significance - Electrochemical cell, reference electrode - Batteries – dry cell -Lead acid battery - Fuel cell - Solar battery- Electrochemical sensors -Relationship between electrical energy and heat energy – Gibbs Helmholtz equation, Photovoltoics

Module 5: Solid State (6L +2T)

Crystal structure-Unit cell, radius ratio -Miller indices, crystal imperfections- Schottky and Frenkel defects - Band theory of solids-types of semi conductors- Intrinsic and Extrinsic semi conductors – Preparation of semiconductors - Super conductors

Module 6: Liquid Crystals (6L +2T)

Liquid crystals –classification, thermotropic and Lyotropic liquid crystals, structure of liquid crystal forming compounds, Chemical properties, Applications of liquid crystals

Reference Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Text Books:

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007

18CH1005	CHEMISTRY FOR CIVIL ENGINEERING	L	T	P	C
		3	1	0	4

Course objectives

1. To make the student conversant with the fundamentals of chemical bonding and nanotechnology
2. To encourage students to develop curiosity towards water technology, corrosion and nanocomposites
3. To acquire knowledge about polymers, paints and concrete.

Course outcomes

The Student will be able to

1. formulate electronic structures and correlate its properties
2. realize the potential applications of polymers
3. relate the unique properties of nanomaterials and explain methods of fabricating nanostructures
4. analyze the *components present in paints and concrete*
5. learn the various factors in water quality and its technology
6. describe the process of corrosion and its prevention

Module 1: Chemical Bonding (9L + 3T)

Types of bonding – Ionic, Covalent, Coordinate bond, Vanderwaals forces, Hydrogen bond, Metallic bond VB theory – Hybridization MO theory, bond order- Homonuclear and Hetronuclear diatomic molecules

Module 2: Polymers (9L + 3T)

Polymers – Introduction, functionality, tacticity of polymers, Classification – natural, synthetic - Addition polymer, condensation polymer, copolymer- Forces between polymeric chains – thermosetting plastics, thermoplastics- ingredients used in compounding of plastics- compression & injection molding, fiber reinforced plastics- preparation, properties and uses of polyethylene, polyvinyl chloride, Bakelite, epoxy resin, raw rubber – vulcanized rubber – Applications of polymers – conducting polymers

Module 3: Nanomaterials and Fabrication (6L +2T)

Nanomaterials –Classification - Top down and Bottom up Approaches - High energy Ball milling – microfabrication – CVD, sol-gel – Nanomaterials - Fullerenes – Self assembled monolayers –preparation and application - characterization of nanomaterials – Introduction to XRD, SEM -Applications of nanotechnology

Module 4: Water Chemistry (9L + 3T)

Hardness, Units and calculation of hardness - Determination of hardness by EDTA method - Removal of hardness – Zeolite process - Ion – Exchange process, sludge – formation and disadvantages - Scale - sources and disadvantages Internal conditioning – Calgon & carbonate conditioning - Boiler corrosion – causes (DO, CO_2, acids) & removal methods - Desalination – Reverse Osmosis - Municipal water treatment methods.

Module 5: Paint and corrosion (6L + 2T)

Protective Coatings, Introduction, Organic coatings, Paints-constituents of Paints Analysis of oils-acid value, Saponification value, Iodine value, Reichert-Meissl value, Formulation of paints, Failure of a paint film - Corrosion –- Types – Dry (Oxidation corrosion with mechanism) - Wet Corrosion (Galvanic corrosion with mechanism) - Factors influencing Corrosion - Corrosion control methods.

Module 6: Cement and Concrete (6L +2T)

Cement – Introduction – classification, Portland cement – Manufacture – Properties, Setting and Hardening of Portland cement – special cement - Concrete – Introduction, Uses – Curing of concrete, Reinforced concrete construction (RCC), Advantage of RCC, Decay of concrete, Protection of concrete.

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007

18CH1006	APPLIED CHEMISTRY	L	T	P	C
		3	1	0	4

Course objectives

1. To make the student conversant with the fundamentals of chemical bonding, polymers and Organic Chemistry.
2. To encourage students to understand the basis of nanotechnology.
3. To acquire knowledge about Instrumental methods of analysis.

Course outcomes

The Student will be able to

1. Formulate electronic structures and correlate its properties
2. Realize the potential applications of polymers
3. Relate the unique properties of nanomaterials and explain methods of fabricating nanostructures
4. Learn the structure of organic molecules.
5. Predict and understand the reactivity of organic reaction.
6. Apply the instrumental methods for various types of analysis.

Module 1: Chemical Bonding (9L + 3T)

Types of bonding – Ionic, Covalent, Coordinate bond, Vanderwaals forces, Hydrogen bond, Metallic bond VB theory – Hybridization MO theory, bond order- Homonuclear and Hetronuclear diatomic molecules

Module 2: Polymers (9L + 3T)

Polymers – Introduction, functionality, tacticity of polymers, Classification – natural, synthetic - Addition polymer, condensation polymer, copolymer- Forces between polymeric chains – thermosetting plastics, thermoplastics- ingredients used in compounding of plastics- compression & injection molding, fiber reinforced plastics- preparation, properties and uses of polyethylene, polyvinyl chloride, Bakelite, epoxy resin, raw rubber – vulcanized rubber – Applications of polymers – conducting polymers

Module 3: Nanomaterials and Fabrication (6L +2T)

Nanomaterials –Classification - Top down and Bottom up Approaches - High energy Ball milling – microfabrication – CVD, sol-gel – Nanomaterials - Fullerenes – Self assembled monolayers –preparation and application - characterization of nanomaterials – Introduction to XRD, SEM -Applications of nanotechnology

Module 4: Stereochemistry (6L + 2T)

Stereoisomerism- Geometrical Isomerism- Optical Activity- Optical Isomerism, Diastereomers - Optical activity without Asymmetric carbons- E and Z system nomenclature- R and S system nomenclature- D,L system- Conformational isomerism of Butane.

Module 5: Reaction Mechanism (6L + 2T)

Introduction- Homolytic and heterolytic bond fission- Classification of reactions- Types of Attacking Reagents- Inductive effect- Electromeric effect- Resonance effect- Hyperconjucation- Effect of Hybridization- types of Addition reaction- Types of Substitution reaction- Types of Elimination reaction- Mechanism of elimination reaction- Mechanism of Nucleophilic substitution reaction- Steric hindrance

Module 6: Instrumental Methods (9L +3T)

Electromagnetic radiation, relation between wave length, wave number, frequency and energy- General features of absorption photometer – Principles and applications of IR, Raman, UV-Visible, NMR spectroscopy - Flame photometer – Introduction to Atomic Absorption Spectroscopy –Types of Chromatography –Applications

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1 Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980

2 Fundamentals of Molecular Spectroscopy, by C. N. Banwell, 4th Edition, Tata McGraw-Hill India Ltd, 2010

3 Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

4 Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007

5 Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition, Freeman and Company, New York, 2007

18CH2001	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	0

Course Objectives:

1. acquire the knowledge of environmental studies, it's need & importance
2. know about problems related to various types of pollution
3. make the learners sensitive to the environment problems in every professional endeavor in which they participate

Course Outcomes:

The Student will be able to

1. Understand the natural environment and its relationships with human activities.

2. Acquire practical skills for solving pollution related problems
3. Design and evaluate strategies and apply green technologies
4. Identify the methods for sustainable development and for the remediation or restoration of degraded environments.
5. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental and social problems.
6. Analyze the connectivity between the man made activities-Pollution-environmental issues-social problems-eco friendly solutions

Module 1: ENVIRONMENT AND NATURAL RESOURCES: (9L)

Environment - Definition, scope and importance , Renewable and Non-Renewable Resources – Natural resources and associated problems – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Energy resources: Growing energy needs, renewable and non-renewable energy sources, and use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Activity: Field study of local area to document environmental assets.

Module 2: ECOSYSTEMS: (5L) Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs

Module 3: BIODIVERSITY: (6L) Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels -Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity – Activity: Model preparation for Ecosystems / Biodiversity (OR) Documentation of available ecosystems/Biodiversity within Campus.

Module 4: ENVIRONMENTAL POLLUTION (9L)

Definition, Causes, effects and control measures (two) – Air pollution (Cyclone separator, Electrostatic Separator) – Water pollution – Soil pollution – Noise pollution – Thermal pollution – Nuclear hazards – Solid waste management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution. Pollution case studies – Green chemistry– principles of sustainable and green chemistry Activity: Visit-nearby Sewage treatment Water Plant.

Module 5: SOCIAL ISSUES AND ENVIRONMENTAL LEGISLATION (9L)

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting and watershed management –Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, case studies – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness – Activity: Watching Documentary Movies & Video Clips related to environment problems, Social issues and control measures.

Module 6: HUMAN POPULATION AND THE ENVIRONMENT: (7L)

Population growth, Population explosion—Family Welfare Programme – Environment and human health. Human rights – HIV/AIDS – Women and Child Welfare – Role of Information Technology in environment and human health – Disaster management: Foods, earthquake, cyclone and landslides – Case Studies – Activity: Small projects related to environment problems, Social issues and eco friendly technology.

Text book

1. Deeksha Dave, S. S. Katewa, "Text Book of Environmental Studies", 2nd Edition. Cengage Learning India Pvt. Ltd., New Delhi, 2012

2. Raman Shivakumar“ Introduction Environmental science and Engineering” Tata Mc Graw Hill companies,2010.
3. BharuchaErach “Text book on environmental studies” For Undergraduate Courses of all Branches of Higher Education, University Grants Commission, New Delhi, 2004.

Reference Books

1. Trivedi. R.K. “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards” Vol. I and II, Enviro Media.
2. Cunningham, Cooper.C.P. andGorhani, T.H. “Environmental Encyclopedia” Jaico Publ., House, Mumbai, 2001.
3. Abnubha Kaushik, C.P.Kaushik,“Perspectives in Environmental Studies” New Age International Publishers, Third Edition, 2009.
4. B.K.Sharma, “Environmental Chemistry” Comprehensive covering the UGC Syllabus, 11th Edition, Goel Publishing House, Meerut, Eleventh Edition, 2007.

18CH2002	Chemical Applications	L	T	P	C
		3	0	0	3

Course Objectives:

1. To apply chemistry in technology
2. To acquire knowledge in energy and materials
3. To know about the green chemistry and modern analytical techniques

Course Outcomes:

1. To understand the basics of polymers
2. To know about surfactants, lubricants and corrosion
3. To have knowledge on nano materials
4. To know about the metal and alloys
5. To gain knowledge on modern analytical techniques
6. To know about the basic concepts in energy and green chemistry

Module 1: Polymers (9 lectures)

Classification, Tacticity - Tacticity and Functionality of Polymers - Types of Polymerization Addiion, Condensation - Synthesis and properties of Bakelite, PVC, Nylon - Moulding Constituents of Plastics - Thermoplastics and Thermosetting - Vulcanization of Rubber - Applications of Polymers

Module 2: Surfactants and lubricants, corrosion (9 lectures)

Methods of preparation, cleaning mechanism. Critical micelle concentration and its determination - Hydrophobic and hydrophilic interactions. Micelles and reverse micelles.

Detergents. Fricohesity of surfactants. Lubricants-physical and chemical properties, types and mechanism of lubrication -Additives of lubricants and freezing points of lubricants

Corrosion – Introduction - Types – Dry (Oxidation corrosion with mechanism) - Wet Corrosion (Galvanic corrosion with mechanism) - Factors influencing Corrosion - Corrosion control methods.

Module 3: New materials / nano materials (9 lectures)

Nanomaterials – Fabrication – steps - Lithography – Nanolithography – Epitaxial growth – Self assembled monolayers -Molecular and material self assembly – Self assembled monolayer – Carbon nanotubes – Nanoelectronics - Applications of nanomaterials

Module 4: Environmental and green chemistry (6 lectures)

Air and noise pollution. Optimum levels of pollution - Water pollution & Solid waste treatment - Significance and determination of COD and BOD - Greenhouse effect and global warming -E – Waste - radioactive pollution - Applications of green chemistry and green technology

Module 5: Energy Science (6 lectures)

Redox reactions – electrode potential - Nernst Equation - Electrochemical series and significance - Electrochemical cell, reference electrode - Batteries – dry cell -Lead acid battery - Fuel cell - Solar

battery- Electrochemical sensors -Relationship between electrical energy and heat energy – Gibbs Helmholtz equation, Photovoltoics

Module 6: Metal and alloys (6 lectures)

Phase rule and applications to one, two and multi-component systems - Iron-carbon phase diagram.
Types of alloys, carbon steel, alloy steel, alloys of Cu, AL, Pb – Applications of alloys

Text Books:

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. University Chemistry, B. M. Mahan, R. J. Meyers, 4th Edition, Pearson,2009

Reference Books:

1. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
2. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007

18CH2003	POLYMER CHEMISTRY	L	T	P	C
		3	0	0	3

Course objectives

1. To attain complete knowledge about polymers
2. To recognize the structure-property correlation
3. To understand the applications of polymers in various fields

Course outcome

The student will be able to

1. Analyse different mechanisms of polymer formation and use this information in the synthesis of different polymers
2. Evaluate the effect of factors such as polymer structure, molecular weight, branching and diluents on crystallinity
3. Interpret experimental data and determine parameters such as polymerization rates and copolymer composition
4. Distinguish between enthalpic and entropic contributions to polymerisation/crystallization
5. Distinguish between absolute and relative methods for molecular weight determination
6. Assess the effect of synthetic polymers on the environment

Module 1 Introduction

Introduction - definition, origin and nomenclature; Classification and types of polymers (Natural &synthetic; addition & condensation and thermoplastics & thermosetting); Molecular Weight (MW) of polymers- Number and weight averaged MW; Natural polymers, and Biodegradable polymers (PHB)

Module 1I Chemistry of Polymerisation

Step growth polymerization-reactivity of functional group, ester and amide formation; Condensation polymerization (Nylon 66); Free radical polymerization-reaction, mechanism; Ionic polymerization-cationic polymerization-steps, mechanism; Ionic polymerization- anionic polymerization-steps, mechanism; Ionic polymerization- ring opening polymerization-steps, mechanism; Copolymerization-types, graft, block, alternate, random, example; Composition, reactivity ratio;

Module 1II Properties of Polymers

Polymer solution – process of dissolution; Thermodynamics of polymer; Flory-Huggins theory; Theta conditions-solubility parameter (Miscibility); Osmotic pressure-lower critical solution temperature; MW determination method (viscometry); Thermal behaviour of polymers – Melting (T_M) and Glass transition (T_g); Deformation behaviour of polymers; Colligative properties of polymer-osmotic pressure;

Module 1V Applications of Polymers

Lithography – principle and procedure; Photolithography; Electron beam lithography; X-ray lithography; Ion beam lithography; Conducting polymers-example-types-properties, applications; Photonic

applications, optical information storage; Polyester-Fibres-mechanical property-crystallinity; Stress and strain behaviour; Carbon fibres and nanotubes – introduction and applications;

Unit V Polymer Composites

Introduction - Polymer blends; Polymer composites – characteristics and types; Introduction to Nano-composites; Clay, CNT and particle filled nanocomposites; Advantages and limitations of nanofillers; Surface treatment on nanofillers

Text books:

1. "Polymer Science" V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar, New Age Intl. Publishers, (2008).
2. "Textbook of Polymer Science", F W Billmeyer, Wiley India (2007).

Reference Books:

1. "Introductory Polymer Science", S K Bashin and Rekha Mann, Dhanpat Rai Publishing Co., (2008)
2. NPTEL Polymer Chemistry Course, D. Dhara, IIT Kharagpur
3. Polymer chemistry and Physics of Modern Materials, 2nd edn, J. M. G. Cowie, Stanley Thornes, UK, 1998
4. Contemporary Polymer Chemistry, 3rd edn. H. R. Allcock, F. W. Lampe and J. E. Mark, Pearson.

18CH2004	Experiments in Polymer Chemistry	L	T	P	C
		0	0	4	2

Course Objectives:

1. Have a hands on experience on synthesis of different polymers
2. Analyze the properties of polymer
3. Learn different characterisation technique

Course Outcome

The Student will able to

1. Understand importance of molecular weight of polymers
2. Measure molecular weight and osmotic pressure of polymers
3. Realize the significance of Colligative properties of polymers
4. Know the different synthetic routes of polymers
5. Recognize the importance of epoxy resin
6. Analyze the thermal properties of polymers

List of experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

18CH3001	Research Methodology and IPR	L	T	P	C
		3	0	0	3

Course Objectives:

1. To make the student conversant with Chemical Abstracts for their Literature collections
2. To encourage students to develop curiosity towards commercial Chemistry softwares for their research
3. To acquire knowledge about chemical reaction set-up and its scientific relevence.

Course Outcomes:

The Student will be able to

1. formulate the chemical reaction design and set-ups
2. realize the potential applications of chemical softwares
3. relate the available informatics applications for the design of potential molecules
4. analyze the *components of rating like impact factor, citation index*

5. learn the procedure for IPR
6. describe a research problem using the available chemistry resources.

Module 1: Chemical Literature Databases: Chemical/Beilstein abstracts, CAS Number, DOI, Citation Index, Impact Factors, *h*-index, Scifinder/Reaxys design, Keyword Text Search, Sub-structure search Identification of Research Problems, Scopus and Web of Sciences.

Module 2: Chemistry Softwares: Structure Tools, Chemical drawings and Chiral representations, Chemsketch, BioRad, Chemoffice, Chemdraw, 3D representation, Energy Minimization process, Substructure identifications, Chemical Structures for manuscript (ACS, RSC, Elsevier), Chemical compounds and Suppliers identification.

Module 3: Chemical Reaction Design: Karl-Fisher Titrations for moisture content, Dean Stork Reaction set-up, Soxhlet extraction set-up, Barr hydrogenation Apparatus, Concept of Rotary evaporator, Auto Titrator, Reaction monitoring- dry/wet reaction set-up, handling hygroscopic compounds. Low Temperature bath (freezing mixture). Anhydrous conditions.

Module 4: Research Ethics and Technical writing: Effective literature studies approaches, analysis – Plagiarism - Research ethics - Effective technical writing, how to write report, Paper - Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Module 5: Intellectual Property Rights: Nature of Intellectual Property: Patents, Designs, Trade and Copyright - Process of Patenting and Development: technological research, innovation - patenting, development. International Scenario: International cooperation on
Intellectual Property. Procedure for grants of patents, Patenting under PCT - Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Reference Books:

1. R. Burns, "Introduction to Research Methods", Addison Wesley Longman, Third Edition, 1997 1. C. R. Kothari, "Research Methodology: Methods and Techniques", New- Age International, 2008
2. S.Usharani, "Analytical Chemistry", first edition, Mcmillan, India Ltd, 2000.
3. Vogel's Text Book of Practical Organic Chemistry by Furiniss, Harnaford, Smith, Talchall, VII Edition 2010.

18CH3002	Tribology of Polymer Composites	L	T	P	C
		3	0	0	3

Course objectives

1. Understand the properties of polymers
2. Recognize the importance of wear and tear of materials in particular polymers
3. Be aware of the applications of polymer and their composites in various fields

Course outcome

The student will be able to

1. Acquire basic knowledge about polymers
2. Recognize the polymer composites and their fabrication processes
3. Appreciate the fundamentals of tribology
4. Identify various types of friction and wear test modes
5. Correlate the friction and wear behaviour of polymers with various material as well as operating properties
6. Realize the influence of nanofillers on friction and wear properties of polymer nanocomposites

Module 1. Introduction to Polymer

Introduction to material – metal, polymer and ceramic; Polymers – functionality and tacticity; classification of polymers –force that exists between the polymer chain; structure-property relationships;

Thermal behaviour of polymers - Tg, Tm and their relationships; Elastic effect of polymers – Hooke, Newton, Maxwell and Voight models -.

Module 2. Polymer Composites

Polymer composites – Introduction; types of composites – particle filled, short and long fibre reinforced; laminates; filler-matrix interaction; Fabrication of polymer nano-composites - Compounding of plastics – additives added and their significance – moulding process – injection and compression moulding, lamination, hand lay-up and filament winding techniques; Characterisation – mechanical and thermal-;

Module 3. Basic Concepts of Tribology

Tribology – Basic concept and its economical importance; Introduction to friction, wear and lubrication; Factors influencing friction and wear of polymers; advantages of polymers over metal; Friction and Wear studies – abrasive, adhesive, erosive, fretting wear modes -; Various types of wear test rigs – Pin-on-disc, block-on-ring.;

Module 4. Tribology of Polymer Composites

Friction and Wear studies - polymer composites in different wear modes; Influence of operating parameters viz. load, speed, counter-face roughness.; correlation between material properties and wear behaviour; Worn surface analysis;-

Module 5. Tribology of Polymer Nanocomposites

Polymer nanocomposites – introduction; various types of nanofillers; advantages and limitations of nanofillers; surface treatment of nanofillers; effect of nanofillers on friction and wear behaviour of polymers; Worn surface analysis; applications of polymer nanocomposites – automotive and mechanical components;

Reference Books:

1. J. Paulo Davim (Ed.), "Tribology of Nanocomposites", Materials Forming, Machining and Tribology series, Springer, 2013.
2. A. S. Paipetis and V. Kostopoulos (Ed.), "Carbon Nanotube Enhanced Aerospace Composite Materials", Solid Mechanics and its Applications Series, G. M. L. Gladwell (Ed.), Springer, 2013.
3. Y. W. Mai and Z. Z. Yu, "Polymer Nanocomposites", Woodhead Publishing Ltd., Cambridge, England, 2006.
4. Peter C LeBaron, Z. Wang and T. J. Pinnavaia, "Polymer Layered Silicate Nanocomposites: an overview", Applied Clay Science vol. 15 pp 11-29, 1999.
5. P. Ma, N. A. Siddiqui, G. Marom and J. Kim, "Dispersion and Functionalisation of Carbon Nanotubes for Polymer based Nanocomposites: a review", Composites: Part A vol. 41 pp 1345-1367, 2010.
6. Anil Kumar and Rakesh K Gupta, "Fundamentals of Polymer Engineering", Tata McGraw Hill Publication Ltd., New Delhi 2003 (revised and expanded edition).
7. R. J. Yound and P. A. Lovell, "Introduction to Polymers", Stanley Thomas Publishers, London, 2000.

18CH3003	Laboratory Chemistry for the Daily Life	L	T	P	C
		0	0	3	2

Course Objectives

1. To make the student familiar with ayurvedic products in daily life
2. To encourage students to develop curiosity towards the preparation of cosmetics
3. To acquire knowledge about soaps and detergents

Course Outcomes

The student will be able to

1. formulate Ayurveda tooth paste, mouth was and hair hail
2. prepare instant head ache relief bam and dish wash powders
3. lip balm from vegetable extracts

4. Preparation of phenyl and analyzing
5. learn the procedures for preparing natural Insect repellant spray/ointment
6. learn the techniques involved in preparation homemade lotion and cream

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

References:

1. Surfactants, Disinfectants, Cleaners, Toiletries, Personal Care Products Manufacturing and Formulations by NPCS Board of Consultants & Engineers, NIIR Project Consultancy Services, 2016
2. Modern Technology of Soaps, Detergents & Toiletries (with Formulae & Project Profiles) 4th Revised Edition, P. K. Chattopadhyay, NIIR Project Consultancy Services, 2016

18CH3004	POLYMER CHEMISTRY	L	T	P	C
		3	0	0	3

Course objectives

- To attain complete knowledge about polymers
- To know the structure-property correlation
- To understand the applications of polymers in various fields

Course outcome

- Understand the overview of various properties of polymers
- Analyse different mechanisms of polymer formation and use this information in the synthesis of different polymers
- Interpret experimental data and determine parameters such as polymerization rates and copolymer composition
- Evaluate the effect of factors such as polymer structure, molecular weight, branching and diluents on their properties
- Discriminate the different types of industrial polymerisation process and their fabrication techniques
- Know more about various types of novel polymeric nanocomposites

Module I. Basic concepts of polymers 6 hrs

Basic concepts of polymers – classification of polymers – source, polymerisation and its mechanism, force that exists between the polymer chain - polymers tacticity – interpenetrating networks – structure property relationships – polymerization reactions – classifications – polymer resins –reaction of polymers – introduction of new groups – cross linking, isomerisation, cyclisation and degradation reactions

Module II. Principles of polymerization 12 hrs

Principles and mechanisms of polymerization – addition, step growth polymerization and co-ordination (Ziegler-Natta) – reactivity of functional groups – carothers equation – kinetics – characteristics of step growth polymerization – examples – mechanisms, choice of monomers, effect of inhibitors or retarders – examples – co-polymeization – monomer reactivity – ratio – composition, types, the Q-e scheme.

Module III. Polymer properties 7 hrs

polymer solutions – molecular weight determination methods - stereochemistry of polymer – amorphous, crystalline and crystallites – Thermal behaviour of polymers - Tg, Tm and their relationships – Elastic effect of polymers –

Module IV. Polymerization processes and fabrication of plastics 8 hrs

Polymerization processes – bulk, solution, emulsion and suspension – industrially important polymers and their polymerization processes – poly styrene – nylon 6,6 – PET – Compounding of plastics –

additives added and their significance – moulding process – injection, compression and blow moulding, lamination, hand lay-up and filament winding techniques.

Module V. Polymer Nanocomposites 12 hrs

Polymer composites - introduction – filler-matrix interaction, fiber reinforced composites (FRP) – short, continuous fiber reinforced composites, laminates – Introduction to polymer nanocomposites – clay, graphene, CNT, particle filled – advantages and limitations of nano fillers – surface treatment on nano fillers – applications of polymer nanocomposites – automotive, packaging and mechanical components etc. -

Text Books:

8. A. Rudin, "The elements of polymer science and engineering" – Academic press, New York, 1982.
9. V.R. Gowariker, "Polymer Science", 5th Edition, Wiley Eastern Ltd., 1992.
10. G.S. Misra, "Introductory polymer chemistry", New Age International Pvt. Ltd., 1996.
11. Anil Kumar and S.K. Gupta, "Fundamentals of polymer science and engineering" Tata McGraw Hill Publication Ltd., New Delhi, 1978.
12. F W Billmeyer Jr., "Textbook of Polymer Science" 3rd edition, Wiley India 1984.

Reference Books:

1. David Sobolev, "A first course in polymer chemistry", MIR publishers, Moscow 1971.
2. R. J. Young, "Introduction to polymers" Chapman and Hall Ltd., London , 1981.
3. D. H. Morton and Jones, "Polymer processing" Chapman and Hall, London, 1989.
4. J. A. Brydson, "Plastic materials" 4th edition, Butterworth–Heinmann Ltd., London 1995.
5. J. A. Biesenberger and H. Sebastian, "Principles of polymerization engineering" , Wiley Interscience publications, New York, 1988
6. Stephen and Rosen, "Fundamental principles of polymeric materials" 2nd edition, John-Wiley and Sons Inc., New York, 1993.
7. R B Seymour, "Introduction to Polymer Chemistry", Tata McGraw Hill
8. M Alexandre and P Dubois, Material Science and Engineering Review (2000) 1

LIST OF COURSES

Sl.No	Sub Code	NAME OF THE SUBJECT	Credits
1	17CH1001	Instrumental Techniques in Chemistry	2:0:2
2	17CH1002	Applied Chemistry	3:0:0
3	17CH1003	Applied Chemistry Lab	0:0:2
4	17CH1004	Environmental Studies	3:0:0
5	17CH2001	Chemical Bonding and Concepts of Acids and Bases	3:0:0
6	17CH2002	Organic Reaction Intermediates and Stereochemistry	3:0:0
7	17CH2003	Atomic Structure, Thermodynamics and Electrochemistry	3:0:0
8	17CH2004	Chemistry of Transition and Inner-transition Elements	3:0:0
9	17CH2005	Reaction Mechanism and Heterocyclic Chemistry	3:0:0
10	17CH2006	Surface chemistry and Chemical Kinetics	3:0:0
11	17CH2007	Qualitative Analysis and Inorganic Preparations Lab	0:0:2
12	17CH2008	Titrimetric Analysis and Gravimetric Analysis lab	0:0:2
13	17CH2009	Organic Qualitative Analysis Lab	0:0:2
14	17CH2010	Physical Chemistry Lab - I	0:0:2
15	17CH2011	Chemistry In Everyday Life	3:0:0
16	17CH2012	Applied Nanochemistry and Next Generation Materials	3:0:0
17	17CH3001	Chemical Kinetics and Photochemistry	3:1:0
18	17CH3002	Chemical Bonding and Nuclear Chemistry	3:0:0
19	17CH3003	Organic Reaction Mechanism and Stereochemistry	3:1:0
20	17CH3004	Quantum Chemistry and Group Theory	3:1:0
21	17CH3005	Coordination Chemistry	3:1:0
22	17CH3006	Molecular Spectroscopy	3:0:0
23	17CH3007	Chemical Thermodynamics and Electrochemistry	3:0:0
24	17CH3008	Organometallic, Bioinorganic and Solid State Chemistry	3:1:0
25	17CH3009	Synthetic Methodology and Natural Products	3:0:0
26	17CH3010	Qualitative and Quantitative Inorganic Analysis Lab	0:0:4
27	17CH3011	Qualitative and Quantitative Organic Analysis Lab	0:0:4
28	17CH3012	Physical Chemistry Lab	0:0:4
29	17CH3013	Modern Instrumental Analysis Lab	0:0:2
30	17CH3014	Preparative Inorganic Chemistry Lab	0:0:2
31	17CH3015	Synthetic Organic Chemistry Lab	0:0:2
32	17CH3016	Instrumental Methods of Analysis	3:0:0
33	17CH3017	Main Group Chemistry	3:0:0
34	17CH3018	Synthetic Reagents and Concerted Reactions	3:0:0
35	17CH3019	Spectroscopic Methods for Structural Elucidation	3:0:0
36	17CH3020	Supramolecular Chemistry and Green Chemistry	3:0:0
37	17CH3021	Applied Electrochemistry	3:0:0
38	17CH3022	Molecular and Material Self Assembly	3:0:0
39	17CH3023	Polymer Chemistry	3:0:0
40	17CH3024	Analytical Chemistry	3:0:0
41	17CH3025	Medicinal Chemistry	3:0:0
42	17CH3026	Supramolecular Chemistry	3:0:0

17CH1001 INSTRUMENTAL TECHNIQUES IN CHEMISTRY

Credits: 2:0:2

Course Objectives :

Enable the student to

- educate the principles of various types of titrations
- know the instrumentation techniques used in chemistry
- train the practical knowledge of the analytical techniques in chemistry

Course Outcomes :

The student will be able to

- understand the importance of accuracy in measurement of data
- utilize the quantitaive techniques in chemistry
- understand the principles of spectroscopic techniques
- apply the principles of titration techniques
- apply the principles of electroanalytical techniques
- choose the appropriate seperaration technique

UNIT I: VOLUMETRIC AND GRAVIMETRIC ANALYSIS: Data Analysis – Accuracy and Precision - Classification of quantitative methods – Volumetric Analysis – Standardization – Buffer – Neutralization, Complexometric and Redox titrations -Titration – Gravimetry – Conditions of Precipitation - Instrumental Techniques

UNIT II ELECTROANALYTICAL METHODS: Conductometry – Principles - Potentiometry – Reference electrodes – Indicator electrodes – Liquid Junction Potential - Potentiometric titrations - Sensors

UNIT III: SPECTROSCOPIC METHOD OF ANALYSIS: Electromagnetic Spectrum – Principles and applications of Infrared and UV-Visible Spectroscopy – Atomic Absorption Spectroscopy – Principles and Applications – Emission Spectroscopy - Applications

UNIT IV: CHROMATOGRAPHY: Principles – Migration rates of Solutes – Optimization of Column Performance - Applications of Liquid column, Solid/liquid, Liquid/liquid, Ion exchange, HPLC and Gas chromatography

UNIT V: THERMAL METHODS AND WATER ANALYSIS: Thermal Methods – Thermogravimetry – Differential Thermal Analysis – Differential Scanning Calorimetry - Water analysis –Hardness, Akalanity – Food analysis

Practicals:

1. Estimation of sodium hydroxide.
2. Estimation of Fe^{2+} ions.
3. Estimation of Total, Permanent and Temporary hardness by EDTA method.
4. Estimation of Alkalinity in water sample.
5. Estimation of dissolved oxygen in water sample.
6. Estimation of Iodine Content in Iodized Common Salt
7. Estimation of Copper in Brass
8. Estimation of Calcium in Milk Powder
9. Conductometric estimation of an acid.
10. Potentiometric estimation of Fe^{2+} ions.
11. pH Measurements for Acid/Alkali Titration.
12. Estimation of iron in water sample by spectrophotometry.
13. Estimation of Potassium using Flame Photometry
14. Analysis by Thin Layer Chromatography
15. Separation of compounds by Column Chromatography
16. Gravimetric Estimation of Nickel

Reference Books:

1. Willard H, Merrit L, Dean J. A. & Settle F.A., "Instrumental methods of chemical analysis", CBS Publishers and Distributers Pvt. Ltd, New Delhi, 7th edition, 1986.
2. Skoog D. A, West D. M, Holler F. J & Crouch S. R, "Fundamentals of Analytical Chemistry", Cengage Learning India Pvt. Ltd, New Delhi, India, 8th Edition, 2004.
3. Day R. A.& Underwood A. L., "Qunatitative Analysis", 6th Edition, Printice Hall of India Pvt Ltd, New Delhi,2006
4. Christian G.D, "Analytical Chemistry" John Wiley & Sons, 6th Edition, 2004
5. Srivatsava A. K. & Jain P. C, "Chemical Analysis", S. Chand Publications, New Delhi, 3rd edition, 1997.
6. Chatwal G. R & Anand S. K, "Instrumental Methods of Chemical Analysis", Himalaya Publishing House, Mumbai, India, 5th Edition, Reprint 2011.
7. G. Sharma, B K Chaturvedi, Richard E. Wolfe, Basic Analytical Chemistry, DK publishers, 2011

17CH1002 APPLIED CHEMISTRY

Credits: 3:0:0

Course Objectives :

Enable the student to

- Learn the problems associated water treatment methods.
- Understand the concepts of thermodynamics and energy resources
- Classify the types of materials and their applications

Course Outcomes

Students will be able to

- recognize hard water and softening methods
- understand chemical thermodynamics
- identify the types of batteries
- explain the problems associated with corrosion
- appraise the significances of polymers
- utilize the knowledge of advanced materials

Unit I - WATER TREATMENT: Hardness,Units and calculation of hardness, Estimation of hardness by EDTA method, Softening of water – External conditioning - Zeolite process, Ion – Exchange process, Scale and sludge – sources and disadvantages, Internal conditioning – Calgon& Carbonate conditioning, Boiler corrosion – causes (DO, CO_2, acids) & removal methods, Desalination – Reverse Osmosis, Municipal water treatment.

Unit II - THERMODYNAMICS: Thermodynamic Concepts – System, surroundings, open, closed, Isolated system, Mass, Energy, Internal energy & work. Extensive property &Internal property, Exothermic and Endothermic reaction, State function. Thermodynamics process: Isothermal, Adiabatic, Isobaric, Isochoric. Zeroth and first law of thermodynamics – statements with suitable analogy. Enthalpy – relation between pressure, volume and work, ΔH & ΔU**,** Hess's Law and its applications (Heat of reactions & its calculation), Heat and Heat capacity, Relation between Cp&Cv for ideal gases. Cyclic process – Carnot theorem, Entropy – Definition and entropy change in reversible and an irreversible process, spontaneity of a reaction (definition) – Gibb's free energy and standard Gibb's free energy of systems, second law of thermodynamics – statements, Gibb's – Helmholtz equation.

Unit III - ELECTROCHMISTRY: Specific, Molar & Equivalent conductivities (definition),Redox reaction, Electrode potential, Measurement of electrode potential, Nernst equation, Electrochemical series and its importance, Electrochemical cells, Liquid Junction Potential, Batteries – Primary cells (dry and alkaline cells), Secondary cells (lead acid battery), H_2–O_2 fuel cells, Electrochemical sensor – working principle and its applications.

Unit IV - CORROSION & POLYMERS: Corrosion – Types – Dry (Oxidation corrosion with mechanism) and Wet Corrosions (Galvanic corrosion with mechanism) – Factors influencing Corrosion and Control methods. Polymers – Introduction, properties of polymers, applications of polymers in medicine, Polymer blends & alloys, Moulding constituents of plastics, Fabrication – Injection & compression mouldings. Biodegradable polymers – Classification and its applications, Biopolymers – definition and functions of Carbohydrates and Proteins.

Unit V - ADVANCED MATERIALS: Nanomaterials - Introduction, Types with examples (particulate (metal/metal oxide), tubular/fibre (CNT/CNF), layered (Nanoclays, Graphene Oxide) and its properties. Preparation of nanomaterials – Top down (Ball milling, CVD) and Bottom up (Self-assembly, sol–gel), Applications – Medicine & medical implants, Next generation computer technology (High definition), Data & energy storage, Fabric industry, Automotive and aerospace, Environment, Electronics (satellites), Solar cells – photovoltaic cells – need, design, working and its limitations.

Reference Books

1 B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.

2 Engineering Chemistry – A Text book of Chemistry for Engineers Wiley India Pvt. Ltd, 2012.

3 Jain P. C, Monica Jain, A Textbook of Engineering Chemistry, Dhanpat Rai publications, New Delhi, 16th edition, 2015.

4 M.A. Shah, Principles of Nanoscience and Nanotechnology, Narosa Publishing House, New Delhi, 2011.

17CH1003 APPLIED CHEMISTRY LAB

Credits: 0:0:2

Course Objectives:
Enable the student to

- Learn the methods to estimate the amount of substance present in a solution quantitatively.
- analyze the quality of water
- have a hands on experience on the electrochemical and spectrophotometric techniques

Course Outcomes:
Students will be able to

- recognize the effects of hardness of water in industrial applications and its estimation.
- know the merits and demerits of dissolved oxygen in water and their estimation.
- understand the principles of complexometric titrations.
- estimate water contamination using titrations.
- apply the principles of electrochemical techniques.
- understand the principles of spectrophotometry.

12 approved experiments will be notified at the beginning of the semester

17CH1004 ENVIRONMENTAL STUDIES

Credits: 3:0:0

Course Objectives:
Enable the student to

- acquire the knowledge of environmental studies, it's need & importance
- know about problems related to various types of pollution
- make the learners sensitive to the environment problems in every professional endeavor in which they participate

Course Outcomes:
Students will be able to

- Understand the natural environment and its relationships with human activities.
- Acquire practical skills for solving pollution related problems
- Design and evaluate strategies and apply green technologies
- Identify the methods for sustainable development and for the remediation or restoration of degraded environments.
- Integrate facts, concepts, and methods from multiple disciplines and apply to environmental and social problems.
- Analyze the connectivity between the man made activities-Pollution-environmental issues-social problems-eco friendly solutions

Unit I : ENVIRONMENT AND NATURAL RESOURCES: Environment - Definition, scope and importance , Renewable and Non-Renewable Resources – Natural resources and associated problems – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Energy resources: Growing energy needs, renewable and non-renewable energy sources, and use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Activity: Field study of local area to document environmental assets.
Unit II - ECOSYSTEMS AND BIODIVERSITY: Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs -Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels -Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity – Activity: Model

preparation for Ecosystems / Biodiversity (OR) Documentation of available ecosystems/Biodiversity within Campus.

Unit III - ENVIRONMENTAL POLLUTION: Definition, Causes, effects and control measures (two) – Air pollution (Cyclone separator, Electrostatic Separator) – Water pollution – Soil pollution – Noise pollution – Thermal pollution – Nuclear hazards – Solid waste management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution. Pollution case studies – Green chemistry– principles of sustainable and green chemistry Activity: Visit-nearby Sewage treatment Water Plant.

UNIT IV - SOCIAL ISSUES AND ENVIRONMENTAL LEGISLATION: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting and watershed management –Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, case studies – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness – Activity: Watching Documentary Movies & Video Clips related to environment problems, Social issues and control measures.

Unit V - HUMAN POPULATION AND THE ENVIRONMENT: Population growth, Population explosion— Family Welfare Programme – Environment and human health. Human rights – HIV/AIDS – Women and Child Welfare – Role of Information Technology in environment and human health – Disaster management: Foods, earthquake, cyclone and landslides – Case Studies – Activity: Small projects related to environment problems, Social issues and eco friendly technology.

Reference Books:

1. Deeksha Dave, "Environmental Studies", Cengage Learning India Pvt Ltd, New Delhi – 2011
2. Raman Shivakumar ,"Introduction Environmental science and Engineering" ,Tata Mc Graw Hill, 2010.
3. Bharucha Erach, "Text book on environmental studies" For Undergraduate Courses of all Branches of Higher Education, University Grants Commission, New Delhi, 2004.
4. Abnubha Kaushik, Kaushik C.P., "Perspectives in Environmental Studies" New Age International Publishers, Third Edition, 2009.
5. Sharma B.K. "Environmental Chemistry" Comprehensive covering the UGC Syllabus, 11th Edition, Goel Publishing House, Meerut, Eleventh Edition, 2007.

17CH2001 – CHEMICAL BONDING AND CONCEPTS OF ACIDS AND BASES

Credits: 3:0:0

Course Objectives:

Enable the student to

- Learn the types of bonds and theories regarding bonding interactions
- Understand the concepts of acids and bases
- Learn about the allotropy of carbon

Course Outcomess:

Students will be able to

- recognize different types of bonds
- understand the theories of bond
- know the basics of bonding interactions
- explain the concepts acids and bases
- understand the theories of acids and bases
- acquire knowledge about carbon allotropes

UNIT I - Atomic Structure - Bohr Theory - Dual Nature of Electron -Heisenberg Uncertainty Principle -Radial and angular functions -Pauli exclusion Principle - Hund's rule=- Type of bonds –-Covalent bonds -Ionic bond-Coordinate bonds - Melting points -Vander Waal's forces

UNIT II - Preparation of ionic compound-Melting point - Conductivity – Solubility- Structure of ionic compound: Radius ratio - Close Packing -Classification of ionic Structure AX(NaCl,CsCl), AX_2 (TiO_2, CaF_2, SiO_2)Layer Structure (CdF_2) – Lattice energy – Born lande equation. - Defects in Solids : Stoichiometric defects – Non Stoichiometric defects -Born Haber Cycle.

UNIT III - General properties of metals in conductivities, Malleability, Luster -Bond lengths-Theories of bonding: free e^--VB, Molecular bond theory-Conductors, insulators and semiconductors Super conductivity-And Alloys

UNIT IV - Theories: Lewis theory – Sidgwic-Powel theory, -VSEPR Theory: Effect of lone pairs,electronegativity,Example (BF_4, NH_3, H_2O, PCI_5, CIF_3, SF_4, $I_3^-SF_6$, IF_7) VB theory: Hybridization –σ orbital π bonds-Molecular Orbital Theory : LCAO method – rules for linear combination of atomic orbital – Homonuclear diatomic molecules -Heteronuclear diatomic molecules-(NO, CO), -CO_3^{2-}

UNIT V - Introduction of Acids and bases -Arrhenius theory-Bronsted theory of acids and bases-Lewis theory of acids and bases-Carbon allotroph – graphite, diamond, carbon nanotubes, fullerenes-Silicates-Silicones

Reference Books:

1. Lee J. D, "Concise Inorganic Chemistry", Wiley India (P.) Ltd, New Delhi, India, 5th edition, Reprint 2009.
2. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
3. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
4. W. H. Madan, G. D. Tuli, R. D.Madan, "Selected Topics in Inorganic Chemistry", S. Chand & Company Ltd, Reprint 2009.

17CH2002 – ORGANIC REACTION INTERMEDIATES AND STEREOCHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- impart basic understanding about reaction intermediates
- illustrate the concepts of electronic effects
- highlight the importance of stereoisomerism and conformational analysis

Course Outcomes:

Students will be able to

- understand the structural basics of organic compounds.
- Know the various types of organic reactions and their properties.
- Recognize the importance of carbonyl and nitrogen containing compounds
- understand the concept of stereoisomerism.
- Name the compound based on CIP nomenclature.
- Apply the conformational analysis for the cyclic systems

Unit I - INTRODUCTION TO ORGANIC CHEMISTRY: Classification of organic compounds – Functional groups – Nomenclature of Organic compounds – Nomenclature of heterocyclic compounds – Fission of bonds – Electrophiles and nucleophiles (Definition, Discussion on the conditions these are formed) – Carbocation and Carbanion, Free radicals, Arynes (Structure and reaction only; methods to identify these species are not required).

Unit II - ELECTRONIC EFFECTS AND TYPES OF REACTIONS: Inductive effect and field effect – Electron delocalization and resonance, Rules of resonance – Steric inhibition of resonance and steric enhancement of resonance (with only one example for each) – Hyperconjugation – Tautomerism.

Unit III - ALIPHATIC AND AROMATIC CHEMISTRY: Aliphatic carbonyl compounds (aldehydes and ketones) – Aliphatic nitrogen containing compounds – Aromatic aldehydes and ketones – Aromatic nitrogen containing compounds – Azines – Arenediazonium salts.

Unit IV - STEREOCHEMISTRY: Stereoisomerism – Cis-trans isomerism (Definition and examples only) – E, Z nomenclature (Rules and examples only) – Optical isomerism – Cause of optical activity – Racemization – Resolution methods – Absolute configuration – R, S nomenclature – Cahn, Ingold, Prelog nomenclature.

Unit V - CONFORMATIONS: Conformations of Ethane – conformations of cyclohexane – conformations of nono substituted cyclohexane – conformations of disubstituted cyclohexane - Saw-horse, Staggered, Skew, Gauche forms.

Reference Books:

1. J. March. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 4th edn., Wiley Student Edition, John Wiley & Sons Asia Pvt. Ltd., 2005
2. B. Mehta, M. Metha. Organic Chemistry, 3rd edn., Prentice-Hall of India Pvt. Ltd., 2008.

3. R.T. Morrison & R.N. Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt Ltd., Singapore, 2003
4. P.S. Kalsi, Stereo Chemistry Conformation and Mechanism, New Age Publishing Ltd., New Delhi, 2002.
5. Bhupinder Mehta, Manju Mehta, Organic Chemistry, Prentice Hall of India private ltd., New Delhi, 2008.
6. O.D. Tyagi, M. Yadav, A Text Book of Organic Chemistry, Anmol Publishing Ltd., New Delhi, 2002
7. I.L. Finar, Organic Chemistry, Pearson Education Pvt. Ltd., Vol. I & II, 5th Edition, Singapore, 1975

17CH2003 ATOMIC STRUCTURE, THERMODYNAMICS AND ELECTROCHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- understand the basics of Quantum Chemistry
- know the principles of chemical thermodynamics and electrochemistry
- apply the concept of Phase Rule

Course Outcomes:

Students will be able to

- recognize the importance of Quantum Chemistry
- know the importance of Thermodynamics
- understand the significance of Phase rule
- know the principles of electrochemistry
- classify the various types of electrochemical cells
- apply the proper method to prevent corrosion

Unit I - Atomic Structure: Quantum Theory of Radiation – Photoelectric effect – Dalton theory – Thomsons atomic model - Bohr Theory – Dual Character of Electron – Heisenberg Uncertainity Principle – Quantum mechanical model of atom (by Schrodinger) – probability distribution – Quantum numbers.

Unit II - Quantum chemistry: Black body radiation - Planck's quantum theory – wave-particle duality – uncertainty principle – operators and commutation relations – postulates of quantum mechanics - Schrodinger equation – particle in one dimensional and three dimensional box - degeneracy - quantum numbers.

Unit III – Thermodynamics: definition - First law of thermodynamics, relation between C_p and C_v, enthalpies of physical and chemical changes – second law of thermodynamics, entropy, Gibbs-Helmholtz equation – third law of thermodynamics and calculation of entropy

Free energy and entropy of mixing, partial molar quantities, Gibbs-Duhem equation – equilibrium constant, temperature dependence of equilibrium constant

Unit IV - Electrochemistry I: Kohlrausch law - equivalent conductance - molar conductance - Electrode potential – Measurement of electrode potential – Nernst equation for electrode potential – Electrochemical Series – Electrochemical cell or Voltaic cell – Concentration cell – Primary Cell– LeClanche cell - Secondary batteries – alkaline batteries – Lead acid and Li batteries

Unit V - Electrochemistry II: Corrosion – Types – Dry corrosion – mechanism – Nature of oxide layers – examples - Wet corrosion – types – mechanism – galvanic corrosion –examples Differential aeration theory – examples - Liquid metal corrosion - examples - factors influencing the rate of corrosion – prevention of corrosion – inhibitors – types - examples

Reference Books:

1. B.R. Puri, L.R. Sharma and Madan S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., Jalandhar, 2008
2. Peter Atkins, "Elements of Physical Chemistry", OUP Oxford, 6th edition, 2012
3. Samuel H. Maron and Carl F. Prutton, "Principles of Physical Chemistry", fourth edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, reprinted in 2009
4. Un Dash, Op Dharmarha and P.L. Soni, "Text book of Physical Chemistry", Sultan Chand & Sons, New Delhi, 2011
5. A.K Chandra, "Introduction to Quantum Chemistry", Tata McGraw Hill, New Delhi, 1997 (recent edition)

6. J. C. Kuriacose and J.Rajaram, "Thermodynamics for students of chemistry", 3rd Edition, Shoban Lal Nagin Chand & Co., Jalandhar, 1999 (recent edition)
7. Samuel Glasstone, "An introduction to electrochemistry" Atlantic Publishers, 2007

17CH2004 CHEMISTRY OF TRANSITION AND INNER-TRANSITION ELEMENTS

Credits:3:0:0

Course Objectives:

Enable the student to

- Learn the properties of transition metals and f-block elements
- understand the various theories of coordination chemistry.
- Learn the principles of organometallic chemistry

Course Outcomes:

Students will be able to

- Know the properties of transition metal compounds.
- have complete understanding of formation of coordination complexes
- know the various types of isomerism in coordination chemistry
- understand the factors affecting the stability of metal complexes
- apply the 18 electron rule.
- Recognize the importance of f-block elements.

Unit I - Transition Metals: Introduction – Metallic Character – Variable oxidation state – stability of the oxidation states - Complexes – Size of atoms and ions – Density – Melting and boiling points – Reactivity of metals – ionization energies – Colour – Polarization – Incompletely filled d or f shell – Magnetic properties – Measurement of magnetic moments – An example – Catalytic properties – Nonstoichimetry – Abundance

Unit II - Coordination compounds: Double salts and Coordination compounds – Werners work – more recent methods of studying complexes – Effective atomic numbers – Shapes of d orbitals – Bonding of transition metal complexes – Valence bond theory – Crystal field theory – Molecular orbital Theory – Octahedral complexes – effects of crystal field splitting – Tetragonal distortion of octahedral complexes (Jahn Teller distortion)- square planar arrangements – Tetrahedral complexes – Chelates – Magnetism – Extension of the crystal field theory to allow for some covalency

Unit III - Isomerism and Stability in Coordinate compounds: Isomerism – Polymerization isomerism – Ionization isomerism – Hydrate isomerism – Linkage isomerism – Coordination isomerism – Coordination position Isomerism –Geometric isomerism or Stereo isomerism – optical isomerism – Stability – Relationship between stepwise and overall stability constant

UNIT IV - Organometallic Chemistry: Effective Atomic Number - 18-electron rule, metal carbonyls, Metal alkyls, carbenes, carbines and alkenes – Metallocenes – Ferrocene – Preparation – Properties – Uses - Reactions – Homogeneous and heterogeneous catalysis -Wilkinsons catalyst – Ziegler – Natta Catalyst.

Unit V - Inner Transition Elements: Introduction –Electronic structure – Oxidation states – Ionic Radii - Lanthanide contraction – Consequences - Colour and spectra - Magnetic Properties - Abundance – Extraction and uses - Extraction, Properties and Uses of Thorium and Uranium

Reference Books:

1. Lee J. D, "Concise Inorganic Chemistry", Wiley India (P.) Ltd, New Delhi, India, 5th edition, Reprint 2009.
2. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
3. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
4. W. H. Madan, G. D. Tuli, R. D.Madan, "Selected Topics in Inorganic Chemistry", S. Chand & Company Ltd, Reprint 2009.

17CH2005 – REACTION MECHANISM AND HETEROCYCLIC CHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- learn various types of reaction mechanisms
- expect the reaction products and the changes that occur in the structure of organic compounds interacting depending on the type of interactions
- know the role of heterocycles in organic, pharmaceutical and biological chemistry.

Course Outcomes:

Students will be able to

- elucidate the mechanisms of organic reactions
- propose more complex syntheses
- predict the reactivity of an organic compound from its structure
- develop the knowledge on the fundamental theoretical understanding of heterocyclic chemistry
- propose syntheses of heterocycles from the major classes
- get the ability to relate significant chemical properties to structure

Unit I - Aromatic and Aliphatic Nucleophilic Substitutions: The S_NAr mechanism – S_N1 mechanism – Benzyne mechanism – Reactivity – Effect of substrate structure, Leaving group, Attacking nucleophile – Bucherer reaction – Chichibabin reaction – S_N1 and S_N2 mechanisms – Neighboring group participation – Non-classical carbocations – Effect of substrate structure, Attacking nucleophile, Leaving group, and reaction medium on nucleophilic substitution – Ambident nucleophiles and regioselectivity.

Unit II - Aromatic and Aliphatic Electrophilic Substitutions: Arenium ion mechanism – Orientation and reactivity in mono-substituted aromatic rings – Quantitative treatment – Hammett equation – Effect of leaving group – Nitration, Diazonium coupling, Nitrosation, – Mechanisms S_E2 mechanism – S_E1 mechanism – Reactivity – Aliphatic diazonium coupling – Acylation at an aliphatic carbon – The Stork-enamine reaction.

Unit III - Addition and Elimination Reactions: Addition reactions - Electrophilic, Nucleophilic, and free-radical addition to double and triple bonds – Hydration, Hydroxylation, Michael addition, Hydroboration - Addition to carbonyl compounds – Mannich reactionElimination reactions – mechanism – E_1, E_2 mechanisms, Hofmann, Saytzeff rules, Bredt's rule – Chugaev reaction, Hofmann degradation

Unit IV - Heterocyclic Chemistry with one hetero atom: Heterocyclic Chemistry – one hetero atom - pyrrole, furan, thiophene, Pyridine – Preparation, reactions and properties.

Unit V - Heterocyclic Chemistry with two hetero atom: Heterocyclic Chemistry– two hetero atom – pyrazole, imidazole, thiazole, Piperdine – Preparatons, reactions and properties

Reference Books:

1. S. H. Pine, Organic Chemistry, 5th edn., McGraw-Hill, 1987
2. J. March. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 4th edn., Wiley Student Edition, John Wiley & Sons Asia Pvt. Ltd., 2005
3. F. A. Carey & R. J. Sundberg. Advanced Organic Chemistry, Part A and B, 3rd edn. 1990
4. Wamser & Harris, Fundamentals of Organic Reaction Mechanisms, John Wiley (1990).
5. R.T.Morrison & R.N.Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt Ltd., Singapore, 2003
6. Raj.K. Bansal, "Heterocyclic Chemistry", New Age International Publishers, 4th Edition, Reprint, 2009.

17CH2006 SURFACE CHEMISTRY AND CHEMICAL KINETICS

Credits: 3:0:0

Course Objectives:

Enable the student to

- learn the fundamental properties of liquid state and liquid crystals
- understand the principles of colloidal state and surface phenomena
- learn the kinetics of chemical reactions

Course Outcomes:

Students will be able to

- understand the properties of liquid state and liquid crystals

- recognize the importance of surface energy
- know about the colloidal system and their stability
- understand the origin of charges on colloidal particles
- distinguish the kinetics of various types of chemical reactions
- understand the factors affecting the enzyme catlaysed reactions

UNIT I - LIQUID CRYSTALS: The vacancy theory - Vapour pressure - Surface tension & surface energy - Some effects of surface tension - Interfacial tension - Surface active agent - Liquid crystal- introduction - Vapour pressure – temperature - Classification of liquid crystal – smetic and nematic - Compounds exhibiting both smetic and nematic characters -

UNIT II - COLLOIDAL STATE-I: introduction & types -Preparation of lyophobic colloidal solutions – dispersion methods - Preparation of lyophobic colloidal solutions – condensation methods - Purification of colloidal solutions - General properties of colloidal system - Some specific properties of hydrophobic colloidal systems – Origin of charge on colloidal particles - Some specific properties of hydrophobic colloidal systems – Electrical double layer - DLVO theory of stability of Lyophobic colloids - Coagulation of colloidal sols – by the action of electrolyte

UNIT III - COLLOIDAL STATE –II: Electro-kinetic properties - Determination of size of colloidal particles - Emulsions – types & formations - Factors determining the stability of emulsion - Micro-emulsion – qualitative and quantitative theories - Gels – types & preparation - Importance and applications of colloidas - Surfactants – types and HLB - Micelle – formation & types - Critical micelle concentration (CMC) - Factors affecting CMC in aqueous media -

UNIT IV - ABSORPTION: introduction & types - Freundlich & Langmuir adsorption isotherm - BET theory of multilayer adsorption - Modern techniques for investigating surfaces

UNIT V - KINETICS: Chemical kinetics – introduction -Rate of reaction, rate constant, order of reaction - Integration of rate expression for first order reaction - Integration of rate expression for second order reaction - Half-life of first and second order reactions - Catalysis – effect of temperature on reaction rates - Arrhenius equation - Enzyme catalysis

Reference Books:

1. B.R. Puri, L.R. Sharma and Madan S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., Jalandhar, 2008
2. Peter Atkins, "Elements of Physical Chemistry", OUP Oxford, 6th edition, 2012
3. Samuel H. Maron and Carl F. Prutton, "Principles of Physical Chemistry", fourth edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1965 (reprinted in 2009)
4. I.N. Levine, "Physical Chemistry", 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007
5. Un Dash, Op Dharmarha and P.L. Soni, "Text book of Physical Chemistry", Sultan Chand & Sons, New Delhi, 2011
6. K.J. Laidler, "Chemical Kinetics", 3rd Edition 1997, Benjamin-Cummings. Indian reprint – Pearson, 2009
7. A.W. Adamson, "Physical Chemistry of Surfaces", 5th edition, Wiley, 1997 (recent edition)

17CH2007 QUALITATIVE ANALYSIS AND INORGANIC PREPARATIONS LAB

Credits: 0:0:2

Course Objectives:

Enable the student to

- Learn the theoretical basis of qualitative inorganic analysis
- Learn the methods of identification using semimicro analysis
- Get trained for the synthesis of inorganic complexes

Course Outcomes

Students will be able to

- gain the laboratory skills to synthesize the inorganic complexes
- understand the theory and mechanism of formation of metal complexes
- recognize the classification of ions under different groups
- in analyze the mixtures using semi micro analysis

- identify the common ions
- aquire separation skills

12 approved experiments will be notified at the beginning of the semester

Reference Books:

1. Mendham J., Denny R. C., Barnes J. D. and Thomas M. J. K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, Seventh impression 2008.
2. Ramanujam V. V., "Inorganic semimicro qualitative analysis", 3rd edition, The national publishing company, Chennai, India, reprinted 2008.
3. Svehla G., "Vogel's Textbook of Qualititative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, fifth impression 2008

17CH2008 TITRIMETRIC ANALYSIS AND GRAVIMETRIC ANALYSIS LAB

Credits: 0:0:2

Course Objectives:

Enable the student to

- learn quantitative methods of analysis
- understand the importance of titrimetric analysis
- estimate the amount of substance using gravimetric analysis

Course Outcomes:

Students will be able to

- improve their analytical skills with respect to estimation
- recognize the importance of volumetric analysis
- apply the volumetric analysis for the estimation of ions
- understand the theory of various types of titrations
- estimate the amount of substance using gravimetry
- know the theory of gravimetric analysis

12 approved experiments will be notified at the beginning of the semester

Reference Books:

1. Mendham J., Denny R. C., Barnes J. D. and Thomas M. J. K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, Seventh impression 2008.
2. Ramanujam V. V., "Inorganic semimicro qualitative analysis", 3rd edition, The national publishing company, Chennai, India, reprinted 2008.
3. Svehla G., "Vogel's Textbook of Qualititative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, fifth impression 2008

17CH2009 ORGANIC QUALITATIVE ANALYSIS LAB

Credits: 0:0:2

Course Objectives:

Enable the student to

- Identify the functional group of the organic compound
- carryout various types of organic reactions to analyze the organic compound
- Understand the principle of systematic organic qualitative analysis

Course Outcomes:

Students will be able to

- Enhance the knowledge of systematic analysis of an organic compound
- Understand the mechanism of the various reactions.
- Recognize the importance of analyzing a organic compound
- Employ various organic reaction types

- apply the knowledge in analyzing real samples
- Prepare derivatives for the given organic compound

12 approved experiments will be notified at the beginning of the semester

Reference Books:

1. A.I. Vogel – "Text book of practical organic chemistry", 5th Ed. ELBS, London, 1989
2. B.B. Dey and M.V. Sitharaman, "Laboratory manual of Organic Chemistry" Revised by T.R. Govindachari, Allied Publishers Ltd., New Delhi, 4th Revised edition, 1992
3. Daniel R. Palleros, "Experimental Organic Chemistry" John Wiley & Sons, Inc., New York, 2000
4. B.S. Fumiss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, "Text book of Practical Organic Chemistry", LBS, Singapore, 1994
5. S.M. Khopar, "Basic concepts of Analytical Chemistry", John Wiley & Sons, 1984
6. Gnanapragasam N.S., Ramamurthy G, "Organic Chemistry Lab Manual", revised edition, S. Viswanathan printers and publishers Pvt. Ltd., Chennai, Reprinted 2011.

17CH2010 PHYSICAL CHEMISTRY LAB – I

Credits: 0:0:2

Course Objectives:

Enable the student to

- train the students on instrumental methods of analysis
- carryout experiments on chemical kinetics
- get an basic idea about electrochemistry

Course Outcomes:

Students will be able to

- Understand the principle and working of various instrument methods of analysis.
- apply the principle of chemical kinetics
- apply the knowledge in measuring real samples
- distinguish different terms used to express concentration
- understand the factors affecting the reaction rate
- utilize the knowledge of electroanalytical techniques

12 approved experiments will be notified at the beginning of the semester

Reference Books:

1. S.M. Khopar, "Basic concepts of Analytical Chemistry", John Wiley & Sons, 1984
2. Mendham J., Denny R. C., Barnes J. D. and Thomas M. J. K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, Seventh impression 2008.

17CH2011 CHEMISTRY IN EVERYDAY LIFE

Credits: 3:0:0

Course Objectives :

Enable the student to

- learn the chemistry connections of everyday life.
- relate the chemistry involved in day-to-day life
- develop a sense of responsibility towards the environment to safeguard.

Course Outcomes :

Students will be able to

- know the practical aspects of chemistry in day-to-day life.
- apply the chemistry concepts in day-to-day activities.
- think innovative and develop application oriented products.
- gain knowledge in buying certified food products

- make right choice in choosing the right food.
- gain right perspective to guard the environment

Unit I - DRUGS AND DISEASES: Clinical chemistry – antibiotics, antiseptics, antipyretics – definitions, examples (common drugs available in the market) – incurable diseases – causes for polio, diabetes, AIDS, cancer – signs and symptoms – vaccination – protein misfolding and disease – common drugs banned in India – effects of using banned drugs – effects of steroidal injections.
Unit II - PERFUMES, EXPLOSIVES, AND DYES: Perfumes: historical significance – the olfactory system – categories – chemistry of ice cream making – chemistry of paint – chemistry of explosives – TNT, RDX, nitrocellulose, nitroglycerine (structure and properties only) – natural dyes and synthetic dyes – types, advantages, applications – hair dye – petrochemicals.
Unit III - CHEMICALS IN EVERYDAY PRODUCTS: Advantages and disadvantages of the following: monosodium glutamate (aginomotto) – lycopene (in tomato) – umami, the fifth taste and glutamate – caffeine and theobromine (in chocolates) – polyphenols (in tea) – docosahexanoic acid (in fish) – thiols (in onion) – polycyclic aromatic hydrocarbons (formed during cooking meat) – constituents of talcum powder and pulmonary fibrosis – ingredients of tooth paste – melatonin (in anti-ageing product) – microban (in toys) – alpha tocopherol (in body lotions) – aluminum chloride (in antiperspirants) – aspartame (in artificial sweetener) – chloral hydrate (in sedatives) – citric acid (in citrus fruits).
Unit IV - CHEMICAL BASIS PF EVERYDAY PHENOMENA: Chemical basis of everyday phenomena – reasoning: kitchen gas burner burns yellow when a pot of boiling water overflows – cosmetic creams feel cool when applied to skin – seashells vary in color – old paintings discolor over time – hair color products remove gray on hair – disappearing inks disappear – water does not relieve the burning sensation of chilly – sniffing dogs detect explosives and bombs – flesh of fish smells different from other meat – puff pastries expand when prepared – some fabrics are water-repellent – cotton is highly water absorbent but dries slowly.
Unit V - KNOWING CHEMISTRY FOR BETTER LIFE: Food adulteration – consumption of alcohol and its ill effects – PAH from oil – balanced diet – iodized salt – fluoride tooth paste – saturated and unsaturated fat - cholesterol (LDL and HDL) – ill health and fast food – organic food – crackers – ill effects of crackers – molecules of emotion (Adrenaline, Acetylcholine, Dopamine**,** Epinephrine, Norepinephrine, Serotonin, Melatonin, Oxytocin).

Reference Books:

1. Karukstis K.K., and Hecke G.R.V., "Chemistry connections: the chemical basis of everyday phenomena" Elsevier Science and Technology books, 2nd edition, 2003.
2. Grace Ross Lewis, "1001 Chemicals in everyday products", John Wiley and sons, 3rd edition, 2001.
3. www.listverse.com/2007/10/04/top-10-incurable-diseases/
4. www.bama.ua.edu/
5. www.foodproductdesign.com
6. www.angelfire.com/linux/chemistryofpaint/
7. www.ssrsi.org/sr1/weapon.explode.htm
8. Paul Engel, "Pain-free Biochemistry", Wiley – Blackwell publishers, 2009.

17CH2012 APPLIED NANOCHEMISTRY AND NEXT GENERATION MATERIALS

Credits: 3:0:0

Course Objectives:
Enable the student to
- understand the various types of nanomaterials
- know the methods of preparation of nanometerials and their characterization
- explore the applications of nanomaterials in various fields

Course Outcomes
Students will be able to
- know the various types of nanomaterials.
- recognize nanomaterials present in nature and various methods available to access them
- understand about the effect of size on the properties of materials
- analyze and characterize nanomaterialsusing various instruments and techniques available

- understand the importance of nanomaterials in electronics and medical field
- think and propose novel materials to replace the present one.

UNIT I - INTRODUCTION TO NANOMATERIALS: Nanomaterials – Emergence of Nanotechnology - Fabrication – Top-down, Bottom-up methods of generation – Surface Energy – Agglomeration – Ostwald ripening – Steric stabilization

UNIT II - CLASSIFICATION OF NANOMATERIALS: Zero Dimensional Nanostructures: Metallic and Semiconductor Nanoparticles – Core-Shell Nanoparticles – One Dimentional Nanostructures- Nanorod – Nanowire – VLS Growth – Electrospinning - Two Dimentional Nanostructures – Thin film — Epitaxy – Physical and Chemical Vapor Deposition - Special nanomaterials – Carbon nanotubes – Fullerenes – Inorganic nanocomposites

UNIT III - NANOSTRUCTURES BY PHYSICAL TECHNIQUES: Lithography – Photolithography – Electron Beam Lithography – Nanolithography – Soft Lithography – Dip Pen nanolithography

UNIT IV - CHARACTERIZATION AND PROPERTIES OF NANOMATERIALS: Structural Characterization - X-ray Diffraction – Scanning Electron Microscopy – Transmission electron Microscopy – Scanning Probe Microscopy – Introduction to Optical Spectroscopy —– Optical – Electrical and Magnetic Properties

UNIT V - APPLICATIONS OF NANOMATERIALS: Nanoelectronics – Biological applications of nanoparticles – Nanomechnics – Photonic crystals

Reference Books:

1. G.Cao, "Nanostructures and Nanomaterials-Synthesis, Properties and Applications", Imperial College Press, London, 2008
2. M.A.Shah and T. Ahnmed, "Principles of Nanoscience and Nanotechnology", Narosa Publishing House, New Delhi, 2010.
3. Atkins, Overton, Rourke, Weller, Armstrong, " Shriver & Atkins Inorganic Chemistry", 4th Editiion, Oxford University Press, New Delhi, 2010
4. Daniel L. Schodek, Paulo Ferreira, Michael F. Ashby, "Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers and Architects" Butterworth-Heinemann Ltd, UK, 2009

17CH3001 CHEMICAL KINETICS AND PHOTOCHEMISTRY

Credits: 3:1:0

Course Objectives:

Enable the student to

- Learn the kinetics of rate equations
- get thorough knowledge about catalysis
- learn the physical properties of electronic excited state

Course Outcomes:

Students will be able to

- understand the types and kinetics of fast reactions
- know the kinetics of flow techniques
- understand the theory of acid – base catalysis
- distinguish different isotherms
- recognize the importance of photosensitization of Chemiluminescence

Unit I - Chemical Kinetics – I: Chemical kinetics – Basic concepts – rate law – rate equation – Kinetics of zero, first, second and third order reactions – Kinetics – composite reactions (complex reaction) – Opposing (reversible) reactions – Consecutive reactions – Chain reactions – Stationary chain reaction –Collision theory of bimolecular and unimolecular reactions – Arrehenius theory of reaction rates – Theory of absolute reaction rates – Thermodynamic treatment of reaction rate - Lindemann's theory – Kinetics of fast reactions.

Unit II - Chemical Kinetics – II: Study of kinetics of stopped flow techniques – flash photolysis – shock tubes – Reaction rates in solution – Effect of dielectric constant and ionic strength – Kinetic isotope effects – Hammett relationship - ionic reactions in solution – effect of ionic strength – Linear free energy relationships – Taft equation – Yukawa-Tsuno equation – Luminescence and energy transformations – Chemiluminescence – reactions in molecular beam.

Unit III – Catalysis: Acid – Base catalysis – general scheme – Arrhenius complex – Vant Hoff's complex – specific and general catalysis – catalytic constants – Bronsted relationship – Hammett acidity functions – mechanism of acid-base catalysed reaction – Catalysis by metal salts (transition metal complex) – enzyme catalysis – theory and applications - Mechanism of heterogeneous catalysis - Langmuir-Hinshelwood mechanism and Langmuir Reidel mechanism - Examples of heterogeneous catalytic reactions - hydrogenation of ethylene, synthesis of ammonia, oxidation of SO_2 and Fischer- Tropsch method for the synthesis of methanol.

Unit IV - Surface Chemistry & Colloids: Adsorption – Difference between adsorption and absorption – Classification of adsorption – Physisorption – Chemisorption – Adsorption isotherm – Freundlisch's adsorption isotherm – Applications of adsorption – Types of solutions – Types of colloidal solutions – Preparation of colloidal solutions – Condensation methods – Disintegraton methods – Purification of colloidal solutions – Dialysis – Ultrafiltration – Characteristics of colloidal solutions – Emulsions – Micelles.

Unit V – Photochemistry: Absorption and emission of radiation – Theories – Spontaneous and induced emission –Laser – Franck Condon principle - Type 1 & 2 – Physical properties of electronic excited state – Emission – Resonance emission – Selection rule – Fluorescence – Phosphorescence – Delayed fluorescence: E-Type and P-Type – Excimer and Exciplex complex formation – Photosensitization and Chemiluminescence – Experimental techniques – Actinometry – Chemical actinometry – Flash photolysis.

Reference Books :

1. Laidler K.J., "Chemical Kinetics", Harper and Row, New York, 3rd Edition, 2008.
2. Rajaram J & Kuriakose, J.C., "Kinetics and mechanism of chemical transformation", McMillan India Ltd., New Delhi, 2011.
3. Adamson, A.W.,"Physical Chemistry of Surfaces", Wiley, 6th edition, 1997.
4. Rohatgi Mukherjee K. K., "Fundamentals of photochemistry", New Age International Pvt. Ltd., New Delhi, 2009.
5. Atkins P.W., "Physical Chemistry", Oxford University Press, 8th edition, 2006.
6. Kalidas, C. "Chemical Kinetic Methods: Principles of Relaxations Techniques and application", New Age International (P) Ltd, Chennai, 2005.
7. Levine I.N., "Physical Chemistry", Tata Mc Graw Hill, NY, 2007.

17CH3002 CHEMICAL BONDING AND NUCLEAR CHEMISTRY

Credits: 3:0:0

Course Objectives :

Enable the student to

- learn the theory of acids and bases and non-aqueous solvents.
- Know about the various types of chemical bonding.
- Learn about nuclear chemistry and their applications

Course Outcomes :

Students will be able to

- have clear knowledge of theory of acids and bases
- recognize the importance and applications of non-aqueous solvents
- understand the various theories of chemical bonding.
- distinguish different types of interactions in molecules
- understand the theory of Nuclear stability
- identify the applications of nuclear chemistry in various fields

UNIT I - ACID-BASE CHEMISTRY: Periodicity – Bronsted-Lowry Theory – Lewis Theory – Measures of acid-base strength - Hard and Soft acids and bases – Classification – Symbiosis – Electronegativity and harness and softness -

UNIT II - NON-AQUEOUS SOLVENTS: Protic and Aprotic solvents - Leveling Effect – Reactions in Non-aqueous solvents –Liquid Ammonia – Sulfuric acid – Hydrofluoric Acid – Sulfur dioxide – Dinitrogen tetroxide -

UNIT III - IONIC BONDING: Lattice energy –Born Lande Equation – Born Haber Cycle – Fajan's rule – Size effects – Factors affecting the radii of ions – Radius Ratio

UNIT IV - COVALENT BOND AND WEAK INTERCATIONS: VB Theory – Hybridization – MO Theory of Diatomic Molecules – Delocalization – Resonance – Electronegativity and MO Theory – Group Electronegativity

- VSEPR Theory – Experimental determination of Molecular structure – Berry pseudorotation – Ion-dipole Interaction – Hydrogen Bonding

UNIT V - NUCLEAR CHEMISTRY: Nuclear Stability – Nuclear Fission – Nuclear Fusion – Radioactive Detectors - Nuclear Reactions - Neutron Activation Analysis – Carbon and Rock Dating –Applications of Tracers

Reference Books:

1. Lee J. D, "Concise Inorganic Chemistry", Wiley India (P.) Ltd, New Delhi, India, 5th edition, Reprint 2009.
2. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
3. Sharpe A.G. "Inorganic Chemistry", Dorling Kindersley (India) Pvt. Ltd, 2nd impression, 2008.
4. Satyaprakash, Tuli G. D, Basu S. K & Madan R. D, "Advanced Inorganic Chemistry" Vol I and II, S. Chand and Company Ltd, NewDelhi, India, Reprint: 2009.
5. Mido Y, Taguchi S, Sethi M.S & Iqbal S. A, "Chemistry in Aquous and Non-aqueous Solvents", Discovery Publishing House, New Delhi, 2003
6. Arnikar H. J, "Essentials of Nuclear Chemistry", New Age International Publishers Ltd., New Delhi, India, 4th edition, 2007.

17CH3003 ORGANIC REACTION MECHANISM AND STEREOCHEMISTRY

Credits: 3:1:0

Course Objectives :

Enable the student to

- impart the importance of chirality in organic compounds
- understand the stereochemistry of organic reactions
- explain the mechanism and molecular rearrangements of organic reactions.

Course Outcomes :

Students will be able to

- understand the reaction pathway in organic transformation
- Improve the skill of proposing mechanism for particular reaction
- propose the expected product based on the mechanism
- explain the selectivity in the organic reactions
- enrich the basic understanding on arrangement of atoms or groups in the space.
- reason out the stereoselectivity in organic reactions in the presence chiral environment

Unit I - REACTION MECHANISM – I: Effect of structure and reactivity – Resonance and field effects – Steric effects – Quantitative treatments of the effect of structure and reactivity – LFER – Hammet and Taft equation - Importance of σ and ρ values in aromatic electrophilic substitutions – Labelling and kinetic isotopic effects. Aromaticity – Huckel's rule – Aromatic systems with electron numbers other than six – Annulenes and Hetero annulenes.

Unit II - REACTION MECHANISM – II: Aliphatic nucleophilic substitution – Mechanisms – SN2, SN1, mixed SN1 and SN2 , SNi, SET, Neighbouring group mechanism – Reactivity – Effect of substrate, attacking nucleophile, leaving group and reaction medium – Substitution at vinylic and allylic carbons. Aromatic nucleophilic substitutions – Mechanism – SNAr – SN1 – Benzyne – Reactivity – Effect of substrate, leaving group and attacking nuclephile.

Unit III - REACTION MECHANISM – III: Aromatic electrophilic substitution – Arenium ion mechanism – Orientation and reactivity in monosubstituted benzene rings – Benzene rings with more than one substituent - Effect of leaving group – o/p ratio – Addition to C-C-multiple bonds – Mechanisms – Electrophilic, nucleophilic, free radical – Orientation and reactivity – Addition to conjugated systems – Elimination – Mechanisms of β elimination – (E2, E1, E1CB) – E1 – E2 – E1CB spectrum, orientation of double bonds – Reactivity – Effect of substrate, attacking base, leaving group and medium.

Unit IV - STEREOCHEMISTRY – I: Stereoisomerism – Definitions and classification – Molecular representation and inter conversion – Classification of stereo isomers – Stereoisomerism and center of chirality – Molecules with a single stereogenic center – Projection structure of stereoisomers – Fischer – DL, RS and EZ notations - Configurational nomenclature – Molecules with two or more chiral centers – Stereoisomerism in cyclic compounds – Axial chirality, planar chirality and helicity.

Unit V - STEREOCHEMISTRY – II: Difference between conformation and configuration – Conformation of ethane, substituted ethanes – Conformation of cyclohexanes, mono, and disubstituted cyclohexanes – Saw-horse, staggered, skew, gauche forms – Explanation and conversion of one representation to another – Fused ring systems – Decalins – Biphenyls - Streoisomerism in Allenes Dynamic stereochemistry: Stereoselectivity and stereospecificity – Curtin-Hammett principle – Enantioselective, diastereoselective synthesis – Enzymatic and kinetic methods – Conformation and reactivity in acyclic compounds and cyclohexanes.

Reference Books :

1. Jerry March, "Advanced Organic Chemistry", Wiley Eastern Limited, New Delhi, 4th edition, 2008.
2. Bahl. B.S. and Arun Bahl, "A Text book of Organic Chemistry", S. Chand & company Ltd., New Delhi, Reprint, 2011.
3. Peter Sykes, "A Guidebook to Mechanism in Organic Chemistry", Longman Press, London and New York, Reprint, 2006.
4. Ernest. L. Eliel, "Stereochemistry of carbon compounds", Tata-McGraw Hill, New Delhi, 22nd Reprint 2009.
5. Nasipuri. D. "Stereochemistry of organic compounds – Principles and applications", New Age international, 2nd edition, 2002.
6. Kalsi. P.S. "Stereochemistry Conformation and Mechanism", New Age International Publishers, New Delhi, 6th Edition, Reprint, 2005.
7. Finar. I.L., "Organic Chemistry, Volume 1", Doorling Kindersley (Indian), 6th Edition, 5th impression, 2008.
8. Raj K. Bansal, "Organic reaction mechanism", Tata McGraw Hill, New Delhi, 4th Edition, 2005.
9. Carey. F.A. "Organic Chemistry", McGraw Hill, Inc., 2nd edition, 1992.
10. Morrison and Boyd, "Organic Chemistry", United States of America, 3rd edition, 1992.
11. Carey, F.A, and Sundberg. R. J, "Advanced Organic Chemistry Part – A:, Plenum Press, 2007.

17CH3004 QUANTUM CHEMISTRY AND GROUP THEORY

Credits: 3:1:0

Course Objectives :

Enable the student to

- learn the importance of quantum chemistry
- understand the concepts of group theory to atoms and molecules.
- know the importance of quantum chemistry and group theory in spectroscopy

Course Outcomes :

Students will be able to

- understand the importance and application of quantization in molecular energy levels
- explain the shape, energy of atomic orbitals and molecular orbitals and the bond formation between atoms
- reason out the spectral behavior of molecules and atoms
- appreciate the symmetry in molecules and in nature
- able to identify and group the objects or molecules of same category based on the symmetry elements
- correlate between symmetry and spectral behavior

UNIT I - INTRODUCTION TO QUANTUM MECHANICS: The failures of classical mecahnism – heat capacities – black body radiation – The photo electric effect – The Compton effect – The diffraction of electrons – wave particles duality- de Broglie Equation- Problems – Hydrogen spectrum- Uncertainty principle, Problems, operators and commutation relations – Postulates of quantum mechanics

UNIT II - QUANTUM CHEMISTRY OF ATOMS AND MOLECULES Scrondinger equation-derivation, Free particle, particle in one dimensional box, three dimensional box Harmonic oscillator, – Rigid rotor – The Schrodinger equation for hydrogen atom – Angular momentum – Spin, coupling of angular momentum – Spin-orbit coupling. Variation and perturbation theory – Application of perturbation / variation theorems to ground state of helium atom

UNIT III - QUANTUM CHEMISTRY OF BONDING: Antisymmetry and Pauli's exclusion principle – Aufbau principle – Slater detrimental wave functions – Term symbols and spectroscopic states – Born Oppenheiner approximation –Linear Combination of atomic orbitals (LCAO), MO and VB treatments of

hydrogen molecule – Hybridization – Huckel theory of linear conjugated systems ethylene, butadiene – Cyclic systems -cyclobutene – Wood- ward Hoffman rules.

Unit IV - GROUP THEORY: Molecular symmetry – symmetry elements and symmetry operations-successive operations, inverse operations - Cartesian coordinate system - relations among symmetry elements - Properties of a group – Abelian, non abelian and Isomorphic groups - Multiplication tables – classes, subgroups - Molecular point groups - Schoenflies symbols - Matrices of symmetry operations - Representations of a group-Reducible and irreducible, representations - Statement and proof of Great orthogonality theorem - Characters and construction of character table (C2v, C3v) – Explanation of a character table - Direct product groups.

Unit V - APPLICATIONS OF GROUP THEORY: Standard reduction formula relating reducible and irreducible representations -Symmetries of normal modes of vibration in non-linear molecules (H2O, NH3, BF3) - Selection rules for vibrational spectra – IR and Raman active fundamentals – Mutual exclusion rule - Symmetries of M.O and symmetry selection rule for electronic transition in ethylene and formaldehyde - Hybridization schemes for atoms in methane, ethylene and butadiene.

Reference Books :

1. Chandra, A.K. "Quantum Chemistry" Tata McGraw –Hill Pvt. Ltd., New Delhi, 4th Edition, 2002.
2. Donald A McQuarrie, "Quantum Chemistry", Viva Books, New Delhi, 2008.
3. Hanna, M.W., "Quantum Mechanics in Chemistry", Addition Wisley, London, 3rd edition, 1981.
4. Swarnalakshmi S. "A Simple Approach to Group Theory in Chemistry" Universities Press, 2009.
5. Raman, K.V. "Group theory and its applications to chemistry", Tata Mac Graw Hill, 2004.
6. Cotton F.A. "Chemical application of group theory", Wiley India Pvt. Ltd., New Delhi, India, 3rd edition, 2009.
7. Carter R.L., Molecular Symmetry and Group Theory, John Wiley & Sons, NY, 2005.

17CH3005 COORDINATION CHEMISTRY

Credits: 3:1:0

Course Objectives :

Enable the student to

- learn the various bonding theories in coordination chemistry and their application in understanding spectra and magnetism
- understand Reaction Mechanism in Coordination Chemistry
- understand the importance of f-block elements and their applications

Course Outcomes :

Students will be able to

- understand the structure, isomerism and bonding in coordination complexes
- characterize the electronic spectra of metal complexes
- predict the magnetic properties of coordination complexes
- understand the factors affecting the stability of metal complexes
- understand the types of mechanisms in reactions of metal complexes
- recognize the chemistry of lanthanides and actinides and their applications

UNIT – I: Theories of coordination Chemistry: Ligands – Classification - Formation of Complexes – Bonding theories – Werner's theory – Sidgwick Theory - VB Theory – Advantages and Defects - Crystal Field Theory – Shapes of d orbitals – Assumptions - CFSE – Measurement of 10Dq - Factors Affecting 10Dq – Spectrochemical Series – Consequences – Merits and limitations of Crystal field theory - MO Theory – σ Bond and π Bond – Advantages

UNIT – II: Electronic and Magnetic Properties: Electronic Spectra — Types of Transitions - Term Symbols – Spin-Spin and Spin-orbit Coupling - Ground Terms for d Configuration, - Problems -Terms Generated in Ligand Fields Correlation Diagrams, - Orgel Diagram – Nephelauxetic Ratio - Racah Parameter -Tanabe Sugano Diagram – Selection Rules for Electronic Transitions - Width of the spectra, Jahn-Teller Effect – Electronic Spectra of d^n Complexes - CT Spectra –Types - Magnetic Properties – Magnetic moment - Determination of Magnetic Susceptibility - Orbital Contribution to Magnetic Moment – Quenching

UNIT – III: Isomerism and Stability: Isomerism - Structural Isomerism – Stereoisomerism – Δ and λ isomers – Cotton effect - Stepwise and Overall Stability Constant - Irwing William Series - Factors Affecting the Stability Constant - Chelate and Macrocyclic Effects – Determination of Stability Constant Problems

UNIT – III: Reaction Mechanism in Coordination Complexes: Thermodynamic and Kinetic Stability - Labile and Inert Complexes - Substitution in Octahedral Complexes – Rate constants for water exchange reactions - S_N1, S_N2 and $S_N1(CB)$ Mechanism - Isomerization Reactions, Anation Reactions - Reactions of Coordinated Ligands - Substitution in square Planar Complexes – Trans Effect – Series - Applications of Trans Effect - Theories of Trans Effect – Electron transfer reactions – Types - Outer and Innersphere Reactions – Marcus Theory –Nature of Bridging Ligand

Unit V: Chemistry of f-block elements: Abundance and Distribution, Uses - Lanthanide Contraction – Magnetic and Spectroscopic properties of Lanthanides - Separation of Lanthanides and Actinides - Transactinides

Reference Books:

1. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
2. Purcell K. F & Kotz J. C., "Inorganic Chemistry" Cengage Learning, New Delhi, India, Reprint, 2010.
3. Greenwood N. N. & Earnshaw A, "Chemistry of the Elements", Reed Elsevier India Private Ltd, Gurgaon, India, 2nd edition, Reprinted 2010.
4. Miessler G. L & Tarr D. A., "Inorganic Chemistry", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 3rd Edition, 2009.
5. Gopalan R, Ramalingam V, Concise Coordination Chemistry, Vikas Publishing House Pvt. Ltd, 2001
6. Cotton F. A & Wilkinson G, "Advanced Inorganic Chemistry", 6th edition, Wiley India (P.) Ltd, New Delhi, India, First Reprint 2007.
7. Jordan R. B, "Reaction Mechanisms of Inorganic and Organometallic Systems", Oxford University Press, New York, USA, 3rd Edition, 2007.
8. Satyaprakash, Tuli G. D, Basu S. K & Madan R. D, "Advanced Inorganic Chemistry" Vol I and II, S. Chand and Company Ltd, NewDelhi, India, Reprint: 2009.
9. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
10. Figgis B. N. & Hitchman M. A, "Ligand Field Theory and Its Applications", Wiley-VCH Verlag GmbH & Co, Weinheim, Germany, 2000.

17CH3006 MOLECULAR SPECTROSCOPY

Credits: 3:0:0

Course Objectives:

Enable the student to

- learn the principles of Molecular Spectroscopy
- understand the principles of Emission Spectroscopy
- learn the theoretical basis of Mossbauer Spectroscopy

Course Outcomes:

Students will be able to

- know the various regions of the spectrum
- Understand the principle of rotation, vibration and electronic spectroscopy
- Know the principle and applications of NMR and ESR spectroscopy
- Understand the principle and applications of fluorescence spectroscopy
- Know the principle and application of photoelectron and mossbauer spectroscopy
- Elucidate the structure of unknown compounds from the spectroscopic data

Unit I - Electromagnetic radiation and Rotation: Introduction to electromagnetic radiation- Regions of the spectrum, characterisation of electromagnetic radiation, Introduction to rotational spectroscopy, rotational spectra diatomic molecules – the rigid diatomic molecule, selection rules for rotational spectra, Effect of isotopic substitution, the non rigid rotator, Polyatomic molecules- Linear molecules, Techniques and instrumentation and chemical analysis by microwave spectroscopy,

Unit II - Vibration and Ramanspectroscopy: Vibrating diatomic molecule, the simple harmonic oscillator, Anharmonic oscillator, The vibration rotation spectrum of carbon monoxide. Born Oppenheimer approximation: the interaction of rotations and vibrations, Vibrations of polyatomic molecules, different modes of stretching and bending, principles – 3N-6 (5) rule, Overtone and combination frequencies, factors affecting vibrational frequencies, Techniques and instrumentation &applications of infrared spectroscopy, Fermi resonance. Raman

spectroscopy- introduction, quantum theory of raman effect, Classical theory of raman effect- molecular polarizability,Polarization of light and the Raman effect,Pure rotational raman spectra- linear, symmetric top and asymmetric top molecules,Vibrational raman spectra, Mutual exclusion principle, overtone and combination vibrations,techniques and instrumentation of Raman spectroscopy,Electronic spectroscopy of diatomic and polyatomic molecules,Transition moment integral, Predissociation

Unit II - NMR and ESR spectrometry: NMR spectroscopy- introduction, Nuclear magnetic resonance phenomenon, The absorption process, Relaxation process- spin spin relaxation,Spin lattice relaxation,Chemical shift, factors influencing chemical shift, ESR spectroscopy – introduction, g factor, Spectra of simple organic radicals, Spectra of first row transition metals, Zero field splitting, Kramer's degeneracy

Unit III - Mossbauer and Photoelectron Spectroscopy: Mossbauer spectroscopy- introduction, principle, Isomer shift, Quadrupole effects,Hyperfine splitting,Applications of Mossbauer spectroscopy. Photoelectron spectroscopy (PES)- PrinciplePhotoelectron spectroscopy (PES)- instrumentation, Ultraviolet Photo electron spectroscopy (UPS)X- Ray Photo electron spectroscopy (XPS)Auger electron spectroscopy

Unit V - Flourescence spectroscopy: Flourescence spectroscopy- introduction, principle, instrumentation, Jablonski diagram, Fluorescence, Phosphorescence, Delayed fluorescence, Characteristicas of Flurescence emission, Fluorescence Lifetimes and quantum yields, Fluorescence Quenching, Resonance energy transfer (RET), Steady state and time resolved Fluorescence.

Reference Books :

1. Fundamentals of Molecular Spectroscopy. C. N. Banwell and E. M. McCash, Tata McGraw-Hill publishing.
2. Molecular Spectroscopy. I. N. Levine, Wiley Interscience Publication.
3. Drago R. S, Physical Methods for Chemists, 2nd Revised edition,n Saunders (W.B.) Co Ltd;
4. Molecular Spectra & Molecular Structure. G. Herzberg, Van Nostrand Reinhold Company
5. Satya Narayana D. N, "Vibrational Spectroscopy Theory and Applications", New Age International Publishers, New Delhi, 2004.
6. Satya Narayana D. N, "Electronic Absorption Spectroscopy and Related Techniques", Universities Press (India) Ltd, Hyderabad, 2001.
7. Lakowicz J. R, "Principles of fluorescence spectroscopy", Springer Science+Business Media, New York, USA, 3rd editon, 2006.
8. Principles of Ultraviolet Photoelectron Spectroscopy, J. W. Rabalais, John Wiley & Sons.
9. Satya Narayana D.N., "Magnetic Resonance Spectroscopy ESR, NMR, NQR", I. K. International, New Delhi, 2009
10. Graybeal J. D., Molecular Spectroscopy.,McGraw Hill.
11. Hollas J. M., Modern Spectroscopy. John Wiley & Sons.

17CH3007 - CHEMICAL THERMODYNAMICS AND ELECTROCHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- learn the fundamentals of classical thermodynamics
- understand the principles of statistical thermodynamics
- know the concepts of electrochemistry

Course Outcomes:

Students will be able to

- understand the influence of temperature on the molecules
- understand the concept of activity and fugacity
- relate various thermodynamic parameters
- understand the distribution of energy among the molecules
- know the relationship between the molecular functions and the thermodynamic parameters
- describe the theoretical background of electrode kinetics

Unit I - First law of thermodynamics – Heat and work, internal energy, enthalpy and heat capacity of a system – Expansion of an ideal gas and changes in thermodynamic property - Limitation of first law of thermodynamics -

Second law of thermodynamics – Carnot cycle (four stroke engine) – Efficiency of heat engine, concept of entropy and its physical significances – Entropy change in phase transformations – Entropy changes of an ideal gas in different processes.

Unit II - Gibbs-Helmhotz equation – variation of Gibbs energy with temperature – Thermodynamics of open system - Partial molar properties – Chemical potential – Gibbs-Duhem equation – Variation of chemical potential with temperature and pressure – Activity – Activity coefficient – Ideal solution – Real solution – Fugacity – Determination of a fugacity of a gas - Third law of thermodynamics – Nernst theorem – Determination of absolute entropy of solids, liquids and gases.

Unit III - Concepts of probability – Entropy and thermodynamic probability – Maxwell-Boltzmann statistics – Basic derivation – prove that $\beta = 1/KT$ – Derivation of Bose-Einstein statistics and Fermi-Dirac statistics – Basic derivation - Relationship between entropy and thermodynamic probability – Molecular partition function for an ideal gas - Derivation of Translational, Rotational, Vibrational partition function –

Unit IV - Derivation of thermodynamic functions in terms of partition function – entropy for monoatomic gases – Sackur-Tetrode equation - Heat capacity of solids – Debye theory and Einstein theory – Irreversible thermodynamics – the steady – coupled flows – application –

Unit V - Steaming potential – electro dialysis – the Dorn effect – electrical double layer – Structure of electrical double layer – Helmholtz model, Gouy-Chapman model and Stern model – Electrode kinetics - Derivation of Butler-Volmer Equation - over potential – decomposition potential.

Reference Books :

1. Atkins P.W., "Physical Chemistry", Oxford University Press, 8th edition, 2006.
2. Glasstone S., "Thermodynamics for Chemists", East West Press Pvt. Ltd., New Delhi, 2005.
3. Levine I.N., "Physical Chemistry", Tata Mac Graw Hill, NY, 2007.
4. N.D. Smith, "Elementary Statistical Thermodynamics", Plenum Press, New York, 1984.
5. Samuel Glasstone, "An Introduction to Electrochemistry", Maurice Press, 2007.
6. John O'M. Bockris, Amulya K. N. Reddy, "Modern Electrochemistry", Vol. I and II, Plenum Publishing, 2008.

17CH3008 ORGANOMETALLIC, BIOINORGANIC AND SOLID STATE CHEMISTRY

Credits: 3:1:0

Course Objectives :

Enable the student to

- learn the Structure, Reactions and Catalysis in Organometallic Chemistry
- know the role of metals in biological chemistry
- understand the importance of inorganic photochemistry and Solid State Chemistry

Course Outcomes :

Students will be able to

- recognize the importance of 18 electron rule
- understand the chemistry of various types of transition metal organometallic complexes
- know the applications of organometallic complexes in catalysis
- identify the metal complexes that can be used for solar energy conversion
- understand the role of metals in biology
- distinguish the structures of various solids

UNIT I - Organometallic Chemistry – structure: 18 Electron Rule - MO theory and 18 electron rule – Electron Counting - Problems - Metal carbonyl complexes - Preparation and Properties - Polynuclear metal carbonyls - Carbonylate anions - Carbonyl Hydride Complexes - Structure prediction for organometallic cluster Metal Nitrosyl Complexes - Metal nitrogen complexes - Alkyl complexes - Chemistry of Metal carbene and Carbyne complexes - Alkene and Alkyne complexes - Allyl and Arene complexes - Metallocenes – Fluxionality

UNIT II - Reactions in Organometallic chemistry and Catalysis: Reactions – Types – Ligand Cone angle – Oxidative addition - Reductive elimination – Insertion – Migration - Nucleophilic and electrophilic attack on coordinated ligands - Carbonylate anions as nucleophiile - Catalysis – Tolman loop – Hydrogenation - Carbonylation - Hydroformylation - Wacker Process - Zeigler-Natta Catalysis

UNIT III - Inorganic Photochemistry: Properties of excited states - Basic Photochemical Processes – Energy transfer – Charge transfer photochemistry – Photodissociation - Photosubstitution reactions – photoisomerization - Photoredox reactions – Ligand Photoreactions – Ruthenium Polypyridine complexes – Photochemical conversion and storage of Solar energy

UNIT II - Biological Inorganic Chemistry: Essential and Trace elements in Biological Systems – Bioinorganic Chemistry of Fe, Co, Cu, Mn and Zn – Metalloporphyrin and Heme - Fe- Oxygen Bindng – Structure and functions of hemoglobin – Myoglobin - physiology of O2 binding - Electron transport – Ferridoxin, rubridoxin - Blue – Copper Proteins – Photosynthesis - Chlorophyll - Enzymes – Model Complexes - Carboxy peptidase - Carbonic anhydrase - Nitrogen Fixation – Hydrogenase - Vitamin B12 and B12 coenzymes – Model complexes - Platinum anticancer drugs – Biomaterials

UNIT-V: Solid State Chemistry: Crystal Systems – Defects – Conductivity in ionic solids - Band Theory of Solids – Close packing in crystals – Radius ratio - Structures of Compounds of types AX – NaCl, CsCl, ZnS , NiAs, Structures of type AX_2 – CaF2, TiO2 – Structures of type ABX_3 – Perovskite, Ilmenite

Reference Books:

1. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
1. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
2. Porterfield W. W, "Inorganic Chemistry A Unified Approach", Reed Elsevier India Private Ltd, Gurgaon, India, 2nd Edition, Reprinted 2009.
3. Purcell K. F & Kotz J. C., "Inorganic Chemistry" Cengage Learning, New Delhi, India, Reprint, 2010.
4. Cotton F. A & Wilkinson G, "Advanced Inorganic Chemistry", 6th edition, Wiley India (P.) Ltd, New Delhi, India, First Reprint 2007.
5. Gupta B. D & Elias A. J, "Basic Organometallic Chemistry", CRC Press, New Delhi, India, 2010.
6. Greenwood N. N. & Earnshaw A, "Chemistry of the Elements", Reed Elsevier India Private Ltd, Gurgaon, India, 2nd edition, Reprinted 2010.
7. K. Hussain Reddy, BIOINORGANIC CHEMISTRY, New Age International Ltd, 2003
8. Bertini I, Gray H. B, Lippard S. J & Valentine J. S, "Bioinorganic Chemistry", Viva Books Private Ltd, New Delhi, India, 2007.
9. West R, "Solid State Chemistry and its Applications", Wiley India Pvt. Ltd, New Delhi, India, 2007.

17CH3009 SYNTHETIC METHODOLOGY AND NATURAL PRODUCTS

Credits 3:0:0

Course Objectives :

Enable the student to

- Learn modern Synthetic Methods using Reagents
- understand the chemistry of heterocycles having 2 or more heteroatoms,
- understand the modern methods for molecular fashions applied in pharmaceutical industry.

Course Outcomes :

Students will be able to

- understand the importance of coupling reactions
- apply modern synthetic reagents in organic synthesis
- identify the applications of heterocycles in various fields
- summarize the extraction and structure elucidation of natural products
- describe the steps involved in the synthesis of natural products
- recognize the importance of biomolecules and their functions

Unit I - Modern Synthetic methods : Coupling reactions: Introduction modern synthetic methodology, concept of coupling reactions and it types, oxidative reduction and reductive elimination, Coupling reactions-HECK reaction, Suzuki Coupling, Stille Coupling, Ullmann reaction, catalytic cycles. Synthetic Reagents : NBS, DDQ, DCC, Gilmann Reagents

Unit II - Modern Synthetic methods using Reagents and Multicomponent reaction Modern Synthetic Reagents : Introduction to multicomponent reactions, Design strategies (3MCRs) and types, Strecker's Reaction, UGI reaction, Passineri reaction, Biginelli reactions and its problems

Unit III - Heterocyclic Chemistry: Introduction and Nomenclature, Structure, synthesis, properties and uses of pyrazine, Imidazole (5 member rings) and Pyridazine, Pyrimidine (6 membered rings).
Unit IV - Natural products and structural elucidation: Natural products extraction, General methods of structure elucidation of alkaloids, Terpenoids, steroids and anthocyanidines, properties and uses.
Unit V - Chemistry of Biological Molecules: Chemistry of Vitamins, Chemistry of carbohydrates, Introduction of Amino acids, Introduction of proteins and its structures and introduction of nucleic acids.

Reference Books:

1. Smith M. B., Organic Synthesis, 3rd Edition, Wave Functions Inc. 2010.
2. Carruthers, W.; Coldham, I. Modern Methods of Organic Synthesis, 04th Edition Cambride University Press, 2004.
3. Joule, J. A. and Mills K. Heterocyclic Chemistry, 05th Edition, Wiley, 2010.
4. Agarwal. O.P, "Chemistry of natural products, Vol.1 & 2", Goel publishing house, 36th Edition, 2009.
5. Raj.K. Bansal, "Heterocyclic Chemistry", New Age International Publishers, 4th Edition, Reprint, 2009.
6. Finar. I.L., "Organic Chemistry", Volume 2, Doorling Kindersley (Indian), 6th Edition, 5th Impression 2008.
7. Gurdeep R. Chatwal, "Organic Chemistry of Natural Products", Himalaya Publishing Home, New Delhi, 5th & Enlarged Edition, 2008.
8. Lehninger Principles of Biochemistry 5th edition, 2008 - Nelson, D. L. and M. M. Cox. (W. H. Freeman &Co.).
9. Organic Chemistry (5th Edn.) Robert. T.Morrison & N. Boyd. Hill edition.

17CH3010 QUALITATIVE AND QUANTITATIVE INORGANIC ANALYSIS LAB

Credits: 0:0:4

Course Objectives :
Enable the student to

- Learn about accurate and precise chemical analysis.
- Learn about the methods used in qualitative inorganic analysis containing common and less common ions
- Classify the various quantitative estimation of metal ions

Course Outcomes :
Students will be able to

- Perform semimicro nalysis
- classify the ions into various groups
- differentiate between common and less common ions
- gain laboratory skills for quantitative estimation
- understand the theory of various types of titrations
- recognize the importance of back titration

Course Description :
12 approved experiments will be notified at the beginning of the semester

Reference Books :

1. Mendham J., Denny R. C., Barnes J. D. and Thomas M. J. K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, Seventh impression 2008.
2. Ramanujam V. V., "Inorganic semimicro qualitative analysis", 3rd edition, The national publishing company, Chennai, India, reprinted 2008.
3. Svehla G., "Vogel's Textbook of Qualititative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, fifth impression 2008.

17CH3011 QUALITATIVE AND QUANTITATIVE ORGANIC ANALYSIS LAB

Credits: 0:0:4

Course Objectives:

Enable the student to

- Learn the identification of the functional group of the organic compound
- obtain the practical skills in setting up of an organic reaction
- identify the elements present in the small organic molecules

Course Outcomes:

The student will be able to

- perform the systematic analysis of an organic compound
- Apply the concept of polarity to separate the organic mixture
- identify various functional groups in the organic mixtures
- Analyze the functional group present in the organic compounds
- Evaluate the given organic mixture by confirmative tests and elemental analysis
- Synthesize the derivatives of the given mixture of organic compounds

12 approved experiments will be notified at the beginning of the semester and estimations of phenol, aniline, ascorbic acid and glucose.

Reference Books:

1. A.I. Vogel – "Text book of practical organic chemistry", 5th Ed. ELBS, London, 1989
2. B.B. Dey and M.V. Sitharaman, "Laboratory manual of Organic Chemistry" Revised by T.R. Govindachari, Allied Publishers Ltd., New Delhi, 4th Revised edition, 1992
3. Daniel R. Palleros, "Experimental Organic Chemistry" John Wiley & Sons, Inc., New York, 2000
4. B.S. Fumiss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, "Text book of Practical Organic Chemistry", LBS, Singapore, 1994
5. S.M. Khopar, "Basic concepts of Analytical Chemistry", John Wiley & Sons, 1984
6. Gnanapragasam N.S., Ramamurthy G, "Organic Chemistry Lab Manual", revised edition, S. Viswanathan printers and publishers Pvt. Ltd., Chennai, Reprinted 2011.

17CH3012 PHYSICAL CHEMISTRY LAB

Credits: 0:0:4

Course Objectives:

Enable the student to

- carryout chemical reaction which would be monitored by electroanalytical and other experimental studies.
- develop skills in the application area of electrochemical techniques experiments.
- Learn the techniques used for kinetics.

Course Outcomes:

Students will be able to

- Apply the physical chemistry concepts in chemical kinetics
- Handle the experiments like Conductometry, Spectrophotometry, Potentiometry.
- Understand the importance of the velocity of the reaction, distribution properties and adsorption studies.
- Recognize the factors affecting the rate of the reactions
- Understand the importance of absorption studies.
- Apply the practical knowledge and its solving route.

Course Description:

12 approved experiments will be notified at the beginning of the semester

Reference Book

1. Svehla G., "Vogel's Textbook of Qualititative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, fifth impression 2008.

17CH3013 MODERN INSTRUMENTAL ANALYSIS LAB

Credits: 0:0:2

Course Objectives:

Enable the student to

- understand theory, instrumentation, and applications of separation techniques
- carryout simple chemical reactions that would be monitored by Conductometry Potentiometry, Spectrophotometry techniques.
- to understand theory, instrumentation, and applications of FT-IR and PXRD

Course Outcomes:

Students will be able to

- handle various analytical techniques like Conductometry Potentiometry, Spectrophotometry and X-ray Diffraction
- Describe physical and chemical principles involved in instrumental analysis and Practical skills
- Understand the principles of data acquisition and data analyses.
- Interpret analytical data and communicate the information about identification of different materials.
- solve qualitative and quantitative analytical problems.
- Choose the instrument for specific characterization

Course Description:

12 approved experiments will be notified at the beginning of the semester

Reference Book

1. Mendham J., Denny R. C., Barnes J. D. and Thomas M. J. K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, Seventh impression 2008.

17CH3014 PREPARATIVE INORGANIC CHEMISTRY LAB

Credits: 0:0:2

Course Objectives :

Enable the student to

- learn the Basic principles of formation ofInorganic complexes
- provide the students an appreciation for the preparation of Inorganic complexes.
- obtain knowledge pertaining to the appropriate selection of instruments for the successful analysis of complex mixtures

Course Outcomes :

Students will be able to

- know the concept of preparation techniques.
- gain the laboratory skills to prepare the inorganic complexes.
- Purify and check the purity of the prepared compounds
- understand the mechanism of the various preparative synthetic steps.
- apply the theory of infrared and ultraviolet spectroscopic techniques.
- characterize the inorganic complexes by spectroscopic techniques

Course Description:

12 approved experiments will be notified at the beginning of the semester

Reference Books :

1. Gopalan R, Ramalingam V, Concise Coordination Chemistry, Vikas Publishing House Pvt. Ltd, 2001
2. Allcock, H, R.,"Inorganic Syntheses", Volume 25, John Wiley & Sons, New York, USA, 1989

17CH3015 SYNTHETIC ORGANIC CHEMISTRY LAB

Credits: 0:0:2

Course Objectives:

Enable the student to

- Develop various skills for preparing organic compounds.
- Know the various organic preparative techniques available.
- Impart awareness about reaction conditions for various types of organic reactions.

Course Outcomes:
Students will be able to

- Design and prepare organic compounds in one step in the lab.
- Purify the prepared organic compound and check the purity of prepared compound.
- Setup the apparatus for various preparative techniques.
- Understand the mechanism of the various preparative synthetic steps.
- Recognize the importance of distillation, refluxing and recrystallization techniques.
- Employ various organic reaction types.

Course Description :
12 approved experiments will be notified at the beginning of the semester

Reference Books :

1. A.I. Vogel – "Text book of practical organic chemistry", 5th Ed. ELBS, London, 1989
2. B.B. Dey and M.V. Sitharaman, "Laboratory manual of Organic Chemistry" Revised by T.R. Govindachari, Allied Publishers Ltd., New Delhi, 4th Revised edition, 1992
3. Daniel R. Palleros, "Experimental Organic Chemistry" John Wiley & Sons, Inc., New York, 2000
4. B.S. Fumiss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, "Text book of Practical Organic Chemistry", LBS, Singapore, 1994
5. S.M. Khopar, "Basic concepts of Analytical Chemistry", John Wiley & Sons, 1984

17CH3016 INSTRUMENTAL METHODS OF ANALYSIS

Credits: 3:0:0

Course Objectives :
Enable the student to

- develop sufficient knowledge about the physical/chemical basis of measurement
- obtain knowledge pertaining to the appropriate selection of instruments for the successful analysis of complex mixtures
- understand the applications of various instrumental techniques

Course Outcomes :
Students will be able to

- understand the range and theories of instrumental methods available in analytical chemistry
- select the appropriate instruments for analyzing complex mixtures
- choose the proper separation technique
- know the importance of thermal methods of analysis
- analyze the sample using microscopic techniques
- recognize the importance of instrumentation techniques in water, food and body fluid analysis

Unit I - Data Analysis: Errors in chemical analysis – Defining terms: mean, median, accuracy and precision – classification of errors: Systematic errors and random errors. Improving accuracy of analysis – mean, standard deviation and Q-test - Principles of Titrations – Instrumental Techniques – Classification – Modern Analytical Techniques
Unit II - Chromatographic methods: Classification – techniques and applications in column, size-exclusion, ion exchange, paper and thin layer chromatography. Gas chromatography and high performance liquid chromatography (HPLC) – principle, equipment design, sample injection system, columns, detectors and applications.
Unit III - Thermal Methods of Analysis: Thermal Characterization techniques Principle and applications of Differential Thermal Analysis (DTA), Differentials Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) Thermometric titration - Theory – Instrumentation – Factors affecting TG, DTA and DSC Curves – Applications
Unit IV - Microscopy methods: Atomic absorption and emission spectroscopy- ICP-AES - X-ray diffraction Methods – Instrumentation –– Diffraction pattern – Structure factor – Reliability factor - Applications – Surface Characterization Techniques – SEM – TEM.
Unit V - Automation and Process control: Water analysis - Food analysis - Body Fluid analysis - Process Instruments – Automation Strategy –Chemical Sensors – Automatic Chemical Analysers – Laboratory Robot

Reference Books:

1. Willard H, Merrit L, Dean J. A. & Settle F.A., "Instrumental methods of chemical analysis", CBS Publishers and Distributers Pvt. Ltd, New Delhi, 7th edition, 1986.
2. Skoog D. A, West D. M, Holler F. J & Crouch S. R, "Fundamentals of Analytical Chemistry", Cengage Learning India Pvt. Ltd, New Delhi, India, 8th Edition, 2004.
3. Day R. A.& Underwood A. L., "Qunatitative Analysis", 6th Edition, Printice Hall of India Pvt Ltd, New Delhi,2006
4. G.D. Chritiain. Analytical Chemistry Wiley
5. Srivatsava A. K. & Jain P. C, "Chemical Analysis", S. Chand Publications, New Delhi, 3rd edition, 1997.
6. Chatwal G. R & Anand S. K, "Instrumental Methods of Chemical Analysis", Himalaya Publishing House, Mumbai, India, 5th Edition, Reprint 2011.
7. Valcarcel**,** Miguel, Principles of Analytical Chemistry, Springer, 2000.
8. G. Sharma, B K Chaturvedi, Richard E. Wolfe, Basic Analytical Chemistry, DK publishers, 2011
9. Zhou W, Wang Z. L, "Scanning Microscopy for Nanotechnology: Techniques and Applications", Springer, New York, USA, 2006.
10. R.P. Braun,Introduction to Instrumental Analysis, McGraw Hill

17CH3017 MAIN GROUP CHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- Understand the synthesis, structure, bonding, and reaction mechanisms of main group Compounds
- learn the chemistry of inorganic polymers
- To understand the bonding in Inorganic cages and clusters

Course Outcomes:

Students will be able to

- understand the structure and bonding in main group Chemistry
- recognize the importance of inorganic polymers
- understand the structure and bonding in inorganic cages and clusters.
- describe the chemical reactivities of B-O, B-N, silicones, polyphosphazene and (SN)compounds.
- know the importance of the electron counting rules
- prepare different Boron hydrides compounds

Unit I - Chemistry of Alkali andAlkaline Earth Metals: Periodic property, Synthesis of Crown ether and Cryptands, Application of Crown ethers in extraction of alkali and alkaline earth metals; Compounds of Beryllium-Aqua and hydroxo complexes, Beryllium chloride, Carbonates, Carboxylates, Dimethylberyllium, Beryllium azide, Grignard reagents and their application.

Unit II - Polymorphism and Allotropy: Allotropes of carbon-Fullerenes, Carbon nanotubes, Diamond, Graphite(synthesis, structure and applications); Allotropes of Phosphorus-Synthesis, Structureand Properties; Allotropes of Sulphur-Classification, Synthesis, Structureand Properties

Unit III - Chemistry of B and C Group Elements: Bonding, Preparation and Structure-Hydrides of boron, Boron oxides, Oxoacids, Borates, Aminoboranes; Chemistry of Silicates; Organometallic Compounds of B, Al, Si, Sn, Pb, and Bi-Synthesis, Structure and Reactions

Unit IV - Chemistry of N,O, Halogen and Noble group Elements: Oxides and oxyacids of S, Se, Te and N-Synthesis, Structures and Properties; Interhalogens,Polyhalides, Pseudohalides- Synthesis and Structure; Xenon compounds- Synthesis and Structure

Unit V - Compounds of Cluster, Cages, Chains and Rings: Hydroborane Clusters, Electron counting schemes: Effective Atomic Number (EAN) Rule – Wade–Mingos Rules, Styx numbers; P–S cages and P–O cages-Synthesis, Structure and Reactivity; Phosphazenes and Poly Phosphazenes; Borazines and Poly Borazines; S-N polymer, Boron nitrides, Polysilanes, Silicones - Carboranes, Metallacarboranes- Synthesis, Structures and bonding

Reference Books:

1. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
2. Greenwood N. N. & Earnshaw A, "Chemistry of the Elements", Reed Elsevier India Private Ltd, Gurgaon, India, 2nd edition, Reprinted 2010.
3. Purcell K. F & Kotz J. C., "Inorganic Chemistry" Cengage Learning, New Delhi, India, Reprint, 2010.
4. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
5. Cotton F. A & Wilkinson G, "Advanced Inorganic Chemistry", 6th edition, Wiley India (P.) Ltd, New Delhi, India, First Reprint 2007.
6. Driess M. & Nöth H, "Molecular Clusters of the Main Group Elements", Wiley-VCH Verlag GmbH & Co, Weinheim, Germany, 2004.
7. Chandrasekhar V, "Inorganic and Organometallic Polymers" Springer-Verlag Berlin, Heidelberg Germany, 2005
8. Henderson W, "Main Group Chemistry", Royal Society of Chemistry, United Kingdom, 2000.
9. Chivers T & Manners I, "Inorganic Rings and Polymers of the p-Block Elements", Royal Society of Chemistry, United Kingdom, 2009.
10. Archer R. D, "Inorganic and Organometallic Polymers", John Wiley and Sons, New York, USA, 2001.

17CH3018 SYNTHETIC REAGENTS AND CONCERTED REACTIONS

Credits 3:0:0

Course Objectives:

Enable the student to

- rationalize, control, and predict the behavior and outcomes of organic reactions
- understand the fundamental principles of Pericyclic and photochemical reactions
- expand and utilize the skills in designing organic synthesis through retrosynthetic approach

Course Outcomes:

Students will be able to

- understand the mechanisms involved in various naming reactions to syntheize their target molecules
- select the appropriate reagents for oxidation and reduction reactions
- know the principles and applications of Pericyclic reactions.
- develop the required skills to execute the various types of Concerted reactions
- design photochemical reactions
- synthesize complex molecules through retrosynthetic approach

Unit I - Organic Name Reactions and Reagents Based On Oxidation and Reduction: Reagents based on Oxidation – PCC – OsO_4 - Reagents based on Reduction – $NaBH_4$, $LiAlH_4$, DIBAL – Name reaction based on Oxidation – Swern Oxidation and Baeyer Villiger Oxidation - Name reaction based on Reduction – Birch Reduction, Meerwein-Ponndorf-Verley Reduction.

Unit II - Photochemical excitation and ketone photochemistry: Light absorption – Experimental techniques – Electronic transitions – Frank – Codon principle – Jablonski diagrams – Intersystem crossing – Energy transfer – Molecular orbital view of excitation – The Geometry of excited states – Reactivity of Electronically excited ketones – α -cleavage – γ- hydrogen transfer Norrish Type I, Type IIreactions – Photoreduction – Oxetate formation – Reactivity of π,π * excited ketones – Photochemistry of α,β - unsaturated ketones– Dienone phenol rearrangement.

Unit III - Photochemistry of alkenes and aromatic compound: Olefin photochemistry – conjugated olefins – Isomerisation and rearrangements – Cis trans isomerisation – valence isomerisation – rearrangement of 1,4 and 1,5 dienes – di π-methane rearrangement - Cope and Claisen rearrangement – cycloaddition reactions – Photochemistry of Aromatic compounds – Arenephotoisomerisation – Photodimerisation –Cycloaddition reactions – 1,2 cycloadditions – Photooxygenation – ene reaction.

UnitIV - Pericyclic Reactions and their stereochemistry: The stereochemistry of electrocyclic reactions – Symmetry properties of molecular orbitals – Symmetry control of electrocyclic reactions – perturbation theory in pericyclic reactions – Woodward Hoffmann rules – orbital correlation diagrams – The Frontier orbital theory – Electrocyclic conversion of 1,3 – dienes and 1,3,5 – trienes. Sigmatrophic reaction – Stereochemistry of sigmatropic reactions – cycloaddition – classification of cycloaddition reaction – orbital symmetry and

cycloaddition – concerted Vs Non-concerted cycloaddition - 2+2 and Diel's Alder reaction – Reactivity of dienophile and diene components – orientation – stereochemistry of Diel's Alder reaction.

Unit V - Reterosynthesis – The Disconnection Approach: Synthons and reagents – Strategy I : The order of events – one group disconnection – Strategy II : Chemoselectivity – Two group Disconnection – Strategy III; Reversal of polarity and cyclization – Strategy IV: proecting groups – Strategy V : Stereoselectivity – Strategy VI : Carbonyl condensation - Strategy VII : Aliphatic nitro compounds – Strategy VIII : Ring synthesis.

Reference Books :

1. Stuart Warren, "Organic Synthesis – The disconnection approach" – A John Wiley and Sons, Ltd., 2nd Edition, reprint, 2010.
2. Jagadamba Singh and Jaya Singh, "Photochemistry and Pericyclic Reactions", New Age International Publishers, New Delhi, 3rd Revised Edition, Reprint, 2011.
3. Carey, F.A, and Sundberg. R. J, "Advanced Organic Chemistry Part – B: Reactions and Synthesis", Plenum Press, 2008.
4. Gurdeep R. Chatwal, "Reaction Mechanism and Reagents in Organic Chemistry", Himalaya Publishing House, New Delhi, 2007.
5. Finar. I. L, "Organic Chemistry", Volume 2, Doorling Kindersley (Indian), 6th Edition, 2008.
6. Hassner. A & Stumber. C, "Organic Synthesis based on name reactions", Pergamon Press, 2002.
7. Ahluwalia. V. K, and Rakesh Kumar Parashar, "Organic Reaction Mechanisms", Narosa Publishing House, New Delhi, 4th Edition, 2011.
8. Gilchrist. T. L, & Storr. R.C, "Organic reaction orbital symmetry", Cambridge university press, 1979.
9. Jerry March, "Advanced Organic Chemistry – Reactions, Mechanisms and structure", John Wiley & Sons, 4th Edition, 2008.
10. Mukherji. S. M, and Singh. S.P, Reaction Mechanism in Organic Chemistry, Macmillan Publishers, 3rd Edition, Reprinted, 2010.
11. Normon and Coxon J.M. Principals of Organic Chemistry, 3rd edition Chapmann and Hall 1993.
12. Coxon. J.M, and Halton. B, "Organic Photochemistry", Cambridge University Press, London, 1st Paper back edition, 2011.

17CH3019 SPECTROSCOPIC METHODS FOR STRUCTURE ELUCIDATION

Credits: 3:0:0

Course Objectives:

Enable the student to

- learn the principles of Molecular Spectroscopy to Organic Molecules
- characterize the organic molecule using various spectroscopic technique
- derive the structure of the molecule using the spectroscopic techniques

Course Outcomes:

Students will be able to

- Understand the principle and applications of UV-Visible and IR spectroscopy
- Elucidate the structure of the unknown compounds using the provided UV Visible and IR spectroscopic data
- Know the principle and applications of NMR spectroscopy
- Classify the types of 2D NMR spectroscopy
- Understand mass spectrometry
- Derive the structure of the unknown organic molecule using the provided spectroscopic data

Unit I - UV Visible spectroscopy and ORD CD: Introduction to UV Visible spectroscopy – principle and instrumentationWoodward–Fieser rules for dienes and trienes – rules and problems,Woodward Fieser rules for α,β-unsaturated compounds – rules and problems,Woodward Fieser rules for aromatic compounds – rules and problems, Applications of UV Visible spectroscopy –poly-ynes, aromatic hydrocarbons other than benzene, heterocyclic systems, Problems on calculating absorption maximum using woodwardfieser rules. Principles of ORD, Instrumentation – Cotton effect, Octant rule, Axial halo ketone rule

Unit II - FTIR spectroscopy: FTIR – principle, instrumentation & the infrared absorption process,FTIR – modes of stretching and bending. Finger print region correlation chart and tables, concept of combination bands and overtones, factors influencing vibrational frequencies,IR spectrum of hydrocarbons: alkanes, alkenes and alkynes,

aromatic rings, alcohols, phenols, ethers and related problems, IR spectrum of carbonyl compounds - aldehydes, ketones and related problems, IR spectrum of carboxylic acids and esters and related problems,IR spectrum of amides, acid chlorides and anhydrides and related problems, IR spectrum of amines, nitriles, isocyanates, isothiocyantaes, imines, nitro compounds and related problems,IR spectrum of sulfur, phosphorous, alkyl and aryl compounds and related problems, Problems in IR spectroscopy.

Unit III - ^{1}H NMR spectroscopy: NMR: Principle, the phenomenon of magnetic resonance, Instrumentaion, Chemical shift, spin – spin relaxation and spin – lattice relaxation**,** Spin-spin coupling, problems based on ^{1}H NMR spectroscopy, Factors influencing chemical shift,Coupling constant- one bond, two bond, three bond and long range coupling,

Unit IV - Multinuclear and 2D NMR spectroscopy: ^{13}C spectroscopy- principle and instrumentation, Difference between ^{1}H and ^{13}C NMR spectroscopy, problems on ^{13}C NMR spectroscopy,Proton decoupled ^{13}C spectra, Simplification of complex spectra, Nuclear Overhauser Enhancement Effect (NOE),Second order spectra, DEPT spectra, problems on DEPT spectra, ^{1}H–^{1}H COSY spectroscopy, HETCOR spectroscopy, NOESY, ROSEY-definition, Problems on ^{1}H, ^{13}C, 2D NMR and DEPT spectroscopy – Introduction to 31P, 19F and Silicon spectroscopy

Unit V - Mass spectrometry: Mass spectrometry: Principle– Instrumentation,Ionization methods – Electron ionization, Chemical ionization, Desorption ionization techniques, Electrospray Ionisation (ESI),Mass spectrum - Molecular ion peak – Base peak Metastable ions, Nitrogen rule, odd even rule,Fragmentation patterns- Mclafferty rearrangement - Isotopic effect - Combined structure problems (with all spectral data, DBE, FTIR, ^{1}H, ^{13}C NMR, DEPT, Mass)

Reference Books:

1. R. M. Silverstein, F. X. Webster, D. J. Kiemle, Spectrometric identification of organic compounds, 7th edition, John Wiley, 2005.
2. Organic Spectroscopy, W. Kemp, 3rd edition, Macmillan, 2011.
3. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, mcgraw Hill, 6th edition 2007.
4. D. L. Pavia and G. M. Lampman Spectroscopy 4th Edition, Brooks Cole, 2012.
5. P. S. Kalsi, Spectroscopy of Organic Compounds, 6th edition, New age international, 2004.

17CH3020 Supramolecular Chemistry and Green Chemistry

Credits: 3:0:0

Course Objectives :

Enable the student to

- learn the supromolecular constructs of current importance.
- Understand the principles of formation of various types of supramolecular architecture
- Know the importance of solid state supramolecular chemistry and green chemistry

Course Outcomes :

Students will be able to

- Understand the various types of bonding in supramolecular chemistry
- know the selectivity in formation of supramolecular chemistry and catalysis.
- synthesize and assemble molecular structures of different shapes and dimensions.
- understand the importance of green chemical pathways in reactions and their applications.
- Construct supramolecular architecture based on of crystal engineering concepts
- Recognize the application of supramolecular chemistry in various fields

UNIT I - INTRODUCTION TO SUPRAMOLECULAR CHEMISTRY: Introduction to supramolecular chemistry – Selectivity – Lock and key principle and induced fit model – complementarity – Co-operativity and chelate effect – Pre-organization – Binding constants – Kinetic and thermodynamic selectivity.

UNIT II - SOLUTION HOST–GUEST CHEMISTRY: Introduction: guests in solution – Macrocyclic vs. acyclic hosts – High-dilution synthesis – Template synthesis – Cation binding – Crown ethers and cryptands – Spherands – Heterocrowns – Biological ligands: ion channels – Anion binding – Charged receptors – Neutral receptors – Lewis acid receptors – Neutral molecule binding – Calixarenes, cyclodextrins and dendrimers as catalysts.

UNIT III - SUPRAMOLECULAR STRUCTURES: Ladders, polygons, and helices – Self-assembly using metal templates – Racks, ladders, and grids – Helicates – Molecular polygons – Rotaxanes, catenanes, and knots – Topological connectivity – Rotaxanes and catenanes as molecular devices – Borromeates – Knots (structure and function of the above species). Self-assembling capsules – Molecular containers – Metal directed capsules – Hydrogen bonded capsules

UNIT IV - SOLID STATE SUPRAMOLECULAR CHEMISTRY: Introduction – Zeolites: structure – Zeolite composition – Zeolites and catalysis – Clathrates – Urea/thiourea clathrates – Trimesic acid clathrates – Hydroquinone and Dianin's compound – Clathrate hydrates (structure and function of the above species) –Uses. Crystal engineering with hydrogen bonds – Pi interactions - Solid state reactivity – Metal-organic frameworks – Guest properties of metal-organic frameworks.

UNIT V - GREEN CHEMISTRY: Need of Green chemistry-Twelve principles of Green chemistry- Green solvents- supercritical carbon dioxide-water as solvent-solvent-free synthesis- applications of Green chemistry-Environmental benign synthesis- catalysis

Reference Books :

1. Jonathan Steed, David Turner, Carl Wallace, Core Concepts in Supramolecular and Nanochemistry, John Wiley & Sons, 2007.
2. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Second Edition, CRC Press, 2012.
3. I. Chorkendorff, J. W. Niemantsverdriet, Concepts of Modern Catalysis and Kinetics, Second Edition, Wiley-VCH Publishers, 2007

17CH3021 APPLIED ELECTROCHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- understand the basics of electrode kinetics
- learn the applications of electroanalytical techniques
- know the types corrosion of materials and electroplating procedures

Course Outcomes:

Students will be able to

- understand the basics of electrokinetics
- know the types of electroanalytical techniques
- understand the types and mechanism of corrosion
- choose the methods to resist corrosion
- understand the principles of electrochemical energy conversion
- classify the batteries based on their application

Unit I - Basics of Electrochemistry: Electodics – Transducers – Macro and Microelectrodes - Polarography – Tast Polarography – Cyclic Voltammetry – Normal pulse and Differential Pulse Voltammetry – Tafel Plot - AC Voltammetry – Impedance Spectroscopy – Spectroelectrochemistry.

Unit II - Corrosion Science: Introduction – Types of corrosion – Theories of corrosion – Mechanism of corrosion – Dry corrosion – Electrochemical corrosion – Types – Passivity – Types – Factors influencing rate of corrosion – Nature of metal, environment – Phorbaix diagram – Corrosion control techniques – Inhibitors – Cathodic protection methods – Corrosion monitoring techniques.

Unit III - Industrial Metal Finishing: Introduction – Objectives of electroplating – Characteristics of electrodeposit and factors – Copper electroplating – alkaline and acid bath – Chromium electroplating – Zinc electroplating – Gold plating – Anodizing and electroforming.

Unit IV - Electrochemical Power Sources – I: Principles of energy conservation - Electrochemical energy conservation- Thermodynamic reversibility - Gibb's equation - Classification of batteries, types of electrolytes - Battery characteristics - Battery specifications - Battery components, Evaluation of battery performance.

Unit V - Electrochemical Power Sources – II: Construction and characteristics of primary batteries: Dry Leclanche cells, alkaline primary batteries and family of lithium batteries - Secondary batteries: Lead acid – car, traction, stationary, standby and sealed batteries. Nickel cadmium – pocket plates and sintered plates – vented and

sealed maintenance free designs. Fuel cells- Introduction, types of fuel cells, advantages – Photoelectrochemical cells.

Reference Books :

1. Bard &. Faulkner, Electrochemical Methods: Fundamentals And Applications, Second Edition
2. Fritz Scholz, Electroanalytical Methods - Guide To Experiments And Applications, 2nd Ed, Springer-Verlag Berlin Heidelberg 2010
3. Joseph Wang, Analytical Electrochemistry, Third Edition 2006 John Wiley & Sons,
4. Vijay G. Singh, Applied Electrochemistry, Nova Science Publishers, 2010
5. John O'M Bockris, Amulya K. N. Reddy, Maria E. Gamboa-Adeco, "Modern Electrochemistry Vol.2 Part 1", Springer Science & Business Media, 2000
6. Raj Narayan, "An Introduction to metallic corrosion and its prevention", Oxford & IBH, 1983
7. Schlesinger, "Modern Electroplating", John Wiley, 2002
8. Jocek Lipkowski and Phil N. Ross, "Electrocatalysis", John Wiley & Sons, 1998
9. Thomas Reddy, "Linden's Handbook of Batteries" 4th Edition, McGraw-Hill, 2010

17CH3022 MOLECULAR AND MATERIALS SELF-ASSEMBLY

Credits: 3:0:0

Course Objectives:

Enable the student to

- Learn the different types of assembly of nanomaterials
- know the bottom-up approach in nanotechnology based on self-assembly.
- Classify the molecular and materials self-assembly on the basis of the driving force needed for them to form.

Course Outcomes:

Students will be able to

- understand the formation of self-assembly in nanomaterials
- describe the process of bottom-up approach based on self-assembly
- give examples of nanocluster self-assembly
- design self-assembled monolayers through different approaches
- understand the fundamental principles of self-assembling block co-polymers
- relate significant self-assembled properties to structure

Unit I - Fundamentals of Self-Assembly and Self-Assembled Monolayers: Self-assembly: definition – Molecular vs. materials self-assembly – Hierarchical self-assembly – Forms, patterns and functions – Self-assembled monolayers (SAMs) – Soft lithography – Microlens arrays – Transfer printing – Electrically contacting SAMs – SAM crystal engineering - Switching SAM function – Chemical reactions on SAMs – Applications of SAMs.

Unit II - Layer–By–Layer Self Assembly: Electrostatic superlattices – Organic polyelectrolyte multilayers – Assembling metallo-polymers – Polyelectrolyte-Colloid multilayers – Graded composition LbL films – LbL MEMS – Crystal engineering of oriented zeolite film – Zeolite-ordered multi-crystal arrays – Cross-linked crystal arrays – Patterned multilayers – Non-electrostatic LbL assembly – LbL self-limiting reactions.

Unit III - Nanorod, Nanowire Self-Assembly: Templating nanowires – Modulated diameter gold nanorods – Self-assembling nanorods – Magnetic nanorods – Magnetic nanorods and nanoclusters – Hierarchically ordered nanorods – Nanorod devices – Nanotubes from nanoporous templates – VLS synthesis of nanowires – Nanowire quantum size effects – Manipulating nanowires – Crossed semiconductor nanowire smallest LCD – Nanowire sensors.

Unit IV - Nanocluster Self-Assembly: Definitions for nanocrystal, nanoparticle, and nanocluster – Synthesis of capped semiconductor nanoclusters – Electrons and holes in nanocluster boxes – Nanocrystal semiconductor alloys – Nanocluster phase transition – Capped gold nanoclusters– Alkanethiolate capped nanocluster diagnostics – Water soluble nanoclusters – Alkanethiolate capped silver nanoclustersuperlattice – Core-shell magneticnanoclusters – Nanocluster- Polymer nanocomposites.

Unit V - Self-Assembling Block Copolymers: Block copolymer self-assembly – Nanostructured ceramics – Block copolymer thin films – Electrical ordering – Spatial confinement of block copolymers – Block copolymer

lithography – Decorating block copolymers – Nanowires from block copolymers – Making micelles – Harnessing rigid rods – Block co-polypeptides – Block copolymer bio-factories.

Reference Books:

1. G. A. Ozin and A. C. Arsenault, "Nanochemistry: A chemical Approach to nanomaterials" RSC Publishing, 2005
2. Zhong Cao G, "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", Imperial College Press, London, United Kingdom, 2004.
3. Nanochemistry, G.B. Sergeyev, Elsevier, 2007.
4. Core Concepts on supramolecular chemistry and nanochemistry, Jonathan Steed, Wiley Eastern Publishers, 2006
5. Nano: The essentials, T. Pradeep, McGraw Hill Publishers, 2007.
6. Supramolecular chemistry –Fundamentals and applications advanced textbook, Katsuhiko Ariga · ToyokiKunitake, Springer-Verlag, 2000.
7. D. Vollatah,,Nanomaterials: An Introduction to Synthesis, Properties and Applications, springer, 2011.

17CH3023 – POLYMER CHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- know the classification and mechanism of polymer formation
- Understand the characterisation techniques used in polymer chemistry
- know concepts of polymer nanocomposites.

Course Outcomes:

Students will be able to

- acquire the basic knowledge about polymers
- choose the methods for characterizing the polymer
- understand the thermal and mechanical properties of various polymers
- develop various fabrication techniques
- understand the filler-matrix interaction
- recognize the importance and applications of nanofillers

Unit I - Basic concepts of polymers – classification of polymers - ladder, star comb - polymers tacticity – interpenetrating network - structure property relationships – naturally occurring polymers – polysaccharides – cellulose and proteins – polymerization reactions – classifications – polymer resins – polymer solutions – reaction of polymers – introduction of new groups – cross linking, isomerisation, cyclisation and degradation reactions- Bio polymers – introduction.

Unit II - Principles and mechanisms of polymerization – addition, step growth polymerization and coordination polymerization (Zeigler-Natta)- reactivity of functional groups – Carothers equation – Kinetics – characteristics of step growth polymerization – examples – mechanisms, choice of polymers, effect of inhibitors or retarders – copolymerization - monomer reactivity – ratio, composition, types, the Q-e scheme.

Unit III - Molecular weight determination methods – polymer stereochemistry – amorphous, crystalline and crystallites – viscous flow – viscosity – thermal behaviour of polymers – T_g , T_m and their relationship – elastic effect of polymers

Unit IV - Polymerization process – bulk, solution, emulsion and suspension – industrially important polymers and their processes – polyethylene – polystyrene – Nylon 6,6 – PET – Natural Rubber – Compounding of plastics – additives added and their significance – Moulding processes – injection, compression, blow moulding

Unit V - Introduction to – conducting polymers and composites, applications in sensors, batteries – conventional composites – filler-matrix interaction, continuous (or long) and short fibre reinforced composites, laminates – introduction to polymer nanocomposites – clay, CNT, particle filled – Advantages and limitations of nanofillers – Surface treatment on nanofillers – Applications of polymer nanocomposites – packaging, automotive, mechanical components

Reference Books:

1. V.R. Gowariker, N.V. Viswanathan, N.V.Jayadev Sreedhar, "Polymer Science", I edition, New Age International Publishers Pvt. Ltd., New Delhi, 2008.
2. G.S. Misra, "Introductory Polymer chemistry", New Age International Pvt. Ltd., 2008
3. Anil Kumar and Rakesh K. Gupta, "Fundamentals of polymer engineering" Tata McGraw Hill Publication Ltd., New Delhi, 2003 (revised and expanded edition)
4. R.J. Young, P.A. Lovell, "Introduction to polymers" Stanley Thomas Publishers, London, 2000
5. P. Bahadur, "Principles of polymer science", Alpha Science International Ltd., 2nd Edition, 2005.
6. G. Odian, "Principles of Polymerisation", IV Edition, Wiley Student Edition, New Delhi, 2007.
7. M.G. Arora, M. Singh and M.S. Yadav, "Polymer Chemistry" II revised Edition, Anmol Publications Pvt. Ltd., 2003

14CH3024 ANALYTICAL CHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- Learn the importance of various analytical techniques used in chemistry
- Understand the principles of different chromatographic separation techniques
- Know the principles and applications of spectroscopic techniques and thermal methods

Course Outcomes:

Students will be able to

- Distinguish between different chromatographic techniques
- Select appropriate technique for analysis
- Plan the analysis of any prepared compound
- Utilize the proper spectroscopic technique for the characterization
- Interpret the spectra obtained from various techniques
- Apply the thermal methods and X-ray diffraction methods

UNIT I – CHROMATOGRAPHY: Theory, instrumentation, basic principles and applications of the following – Column, thin layer, and ion-exchange chromatography – HPLC - applications in chemical analysis – Gas chromatography

UNIT – II - INFRARED SPECTROSCOPY: Introduction to electromagnetic radiation- Regions of the spectrum, characterisation of electromagnetic radiation - The vibrating diatomic molecule – Selection rule - The simple harmonic oscillator - Vibrations of polyatomic molecules – Fundamental vibrations and overtones - Instrumentation –Sampling techniques - Factors influencing vibrational frequencies - Application to organic and inorganic compounds - Finger print region - Identification of functional groups - Simple problems in functional group identification using IR spectrum.

UNIT III - ELECTRONIC SPECTRA: Electronic spectra of diatomic molecules – physical principles – laws of absorption – absorption transitions – chromophores and auxochromes – effects of conjugation – Woodward-Fieser rules for α,β-unsaturated carbonyl compounds and dienes – aromatic systems with extended conjugation – application to organic and inorganic compounds – instrumentation.

UNIT IV - NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Theory- Nuclear spin- Interaction between spin and magnetic field - Population of energy levels - Larmor precession frequency - Relaxation processes – Instrumentation – Continuous wave and FT NMR - Proton NMR - Chemical shifts and its measurement – Reference compound – Factors affecting Chemical Shifts – Solvents used in NMR -Spin-spin coupling – Theory - Magnitude and factors affecting coupling constant - Long Range coupling – Second order spectra – AX, AMX, and ABX systems- Simplification of complex spectra - Applications of 1H NMR to determine the structure of simple organic compounds - Introduction to Two Dimensional NMR (1H-1H COSY) spectroscopy.

Unit V: Thermal Methods of Analysis and X-ray Diffraction method: Thermal Characterization techniques Principle and applications of Differential Thermal Analysis (DTA), Differentials Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) Thermometric titration - Theory – Instrumentation – Factors affecting TG, DTA and DSC Curves – Applications - - X-ray diffraction Methods – Instrumentation — Diffraction pattern – Structure factor – Reliability factor - Applications

Reference Books:

1. Chatwal G. R & Anand S. K, "Instrumental Methods of Chemical Analysis", Himalaya Publishing House, Mumbai, India, 5th Edition, Reprint 2011.
2. Kalsi P. S, "Spectroscopy of Organic Compounds", New Age International Publishers, New Delhi, 6th Edition, 2004.
3. Skoog D. A, West D. M, Holler F. J & Crouch S. R, "Fundamentals of Analytical Chemistry", Cengage Learning India Pvt. Ltd, New Delhi, India, 8th Edition, 2004.
4. Srivatsava A. K. & Jain P. C, "Chemical Analysis", S. Chand Publications, New Delhi, 3rd edition, 1997.
5. Willard H, Merrit L, Dean J. A. & Settle F.A., "Instrumental methods of chemical analysis", CBS Publishers and Distributers Pvt. Ltd, New Delhi, 7th edition, 1986.
6. Valcarcel, Miguel , Principles of Analytical Chemistry, Springer, 2000.
7. G. Sharma, B K Chaturvedi,Richard E. Wolfe, Basic Analytical Chemistry, DK publishers, 2011

17CH3025 MEDICINAL CHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- equip with a thorough understanding of different aspects of pharmaceutical chemistry
- learn about the enzyme kinetics
- understand the various steps and procedures in the drug design

Course Outcomes:

Students will be able to

- understand and apply the design and synthetic approaches used in pharmaceutical chemistry
- recognize the importance of enzyme kinetics
- identify the factors affecting the solubility of the drugs
- know the process of pharmokinetics
- understand the importance of clinical trials
- design some small organic drug molecules

Unit I - Basics of medicinal chemistry: Brief history of medicinal chemistry – classification of drugs – brief description of biological, chemical, computer revolutions in drug design – pro drugs and soft drugs – design of pro drug system – multiple pro drug formation – soft drug principle and applications

Unit II - Drug targets and drug solubility: Enzymes and enzyme inhibitors – competitive and non-competitive inhibitors – reversible and irreversible inhibitors – ligand-receptor theories – Clark's theory and Paton's rate theory – proteins, lipids, and nucleic acids as drug targets – effect of pH, pK_a, and polarity on drug solubility

Unit III - Pharmcokinetics and drug metabolism Natural resources of lead compounds – absorption, distribution, metabolism, and elimination – oxidation and hydrolysis – testing drugs in vitro – high-throughput screening – testing drugs in vivo – therapeutic index and therapeutic ratio

Unit IV - Various phases in preclinical testing and clinical trials – designing organic synthesis – convergent synthesis – patenting and manufacture – complexes and chelating agents – metal clusters – detoxification – drug action and metal chelation

Unit V - Development of new drugs: Five classic steps in the design of a new drug – procedures in drug design – isolation of bioactive compounds – accidental discovery – examination of metabolites – interference with fundamental life processes – exploitation of side effects of drugs - random screening – synthesis of drugs ab initio – molecular modification of lead compounds – factors affecting drug development

Reference Books:

1. Ashutosh Kar, "Medicinal Chemistry" New Age International Publishers, 5th Revised and Expanded edition, 2010.
2. Richard B. Silverman, "The Organic Chemistry of Drug Design and Drug Action", 2nd Edition, Academic Press, Reprinted, 2010.
3. Rama Rao Nandella, "Principles of Organic Medicinal Chemistry" New AgeInternational Publishers, New Delhi, Reprint, 2008.
4. Gareth Thomas "Fundamentals of Medicinal Chemistry", London, Reprint, 2003.

5. David A. Williams, William O. Foye, Thomas L. Lemke, Lippincott Williams & Wilkins, Foye's Principles of Medicinal Chemistry, Philadelphia, 5th edition, 2002.
6. Donald J. Abraham, David P. Rotella, "Burger's Medicinal Chemistry, Drug Discovery and Development, 8 Volume Set, John Wiley & Sons Ltd., 7th Edition, 2003.
7. Graham L. Patrick, "An introduction to Medicinal Chemistry", Oxford university Press, 1995.

17CH3026 SUPRAMOLECULAR CHEMISTRY

Credits: 3:0:0

Course Objectives:

Enable the student to

- Learn the structural and functional basics of building blocks of supramolecular structures
- Know driving forces of supramolecular structure formation
- Classify the supramolecules based on structure and the chemistry behind host-guest assembly.

Course Outcomes:

Students will be able to

- understand the selectivity in supramolecule formation
- identify the various factors affecting the formation of supramolecules
- understand the concepts of solution host-guest chemistry
- design the various types of supramolecular architectures
- recognize the importance of coordination polymers
- apply the supramolecules in various fields

Unit I - INTRODUCTION TO SUPRAMOLECULAR CHEMISTRY: Introduction to supramolecular chemistry – Selectivity – Lock and key principle and induced fit model – complementarity – Co-operativity and chelate effect – Pre-organization – Binding constants – Kinetic and thermodynamic selectivity – Optically active supra-molecules – Self-assembly of intrinsically chiral molecular capsules.

Unit II - SOLUTION HOST–GUEST CHEMISTRY: Introduction: guests in solution – Macrocyclic vs. acyclic hosts – High-dilution synthesis – Template synthesis – Cation binding – Crown ethers and cryptands – Spherands – Heterocrowns – Biological ligands: ion channels – Anion binding – Charged receptors – Neutral receptors – Lewis acid receptors – Neutral molecule binding – Calixarenes, cyclodextrins and dendrimers as catalysts.

Unit III - SUPRAMOLECULAR STRUCTURES: Ladders, polygons, and helices – Self-assembly using metal templates – Racks, ladders, and grids – Helicates – Molecular polygons – Rotaxanes, catenanes, and knots – Topological connectivity – Rotaxanes and catenanes as molecular devices – Borromeates – Knots (structure and function of the above species).

Unit IV - SOLID STATE SUPRAMOLECULAR CHEMISTRY: Introduction – Zeolites: structure – Zeolite composition – Zeolites and catalysis – Clathrates – Urea/thiourea clathrates – Trimesic acid clathrates – Hydroquinone and Dianin's compound – Clathrate hydrates (structure and function of the above species) –Uses.

Unit V - SELF-ASSEMBLING CAPSULES: Self-assembling capsules – Molecular containers – Metal directed capsules – Hydrogen bonded capsules – Concepts in crystal engineering – The Cambridge structural database - Crystal engineering with hydrogen bonds – Pi interactions - Solid state reactivity – Metal-organic frameworks – Guest properties of metal-organic frameworks.

Reference Books:

1. Jonathan Steed, David Turner, Carl Wallace, Core concepts in Supramolecular Chemistry and nanochemistry, John Wiley & sons, 2007.
2. Jean-Marie Lehn, Supramolecular Chemistry, RCS pubs., 2005
3. Supramolecular chemistry –Fundamentals and applications advanced textbook, Katsuhiko Ariga · Toyoki Kunitake, Springer-Verlag, 2000.
4. Nano: The essentials, T. Pradeep, McGraw Hill Publishers, 2007.
5. Nanochemistry, G.B. Sergeyev, Elsevier, 2007.
6. G. A. Ozin and A. C. Arsenault, "Nanochemistry: A chemical Approach to nanomaterials" RSC Publishing, 2005
7. Zhong Cao G, "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", Imperial College Press, London, United Kingdom, 2004.
8. Paul Engel, "Pain-free Biochemistry", Wiley – Blackwell publishers, 2009.

LIST OF COURSES

Sl. No	Course Code	Name of The Course	Credits
1	16CH1001	Applied Chemistry	3:0:0
2	16CH1002	Applied Chemistry for Engineers	3:0:1
3	16CH2001	Chemical Bonding and Concepts of Acids and Bases	3:0:0
4	16CH2002	Organic Reaction Intermediates and Stereochemistry	3:0:0
5	16CH2003	Atomic Structure, Thermodynamics and Electrochemistry	3:0:0
6	16CH2004	Chemistry of Transition and Inner-transition Elements	3:0:0
7	16CH2005	Reaction Mechanism and Heterocyclic Chemistry	3:0:0
8	16CH2006	Surface Chemistry and Chemical Kinetics	3:0:0
9	16CH3001	Research Methodology	3:0:0
10	16CH3002	Molecular and Material Self Assembly	3:0:0

16CH1001 APPLIED CHEMISTRY

Credits: 3:0:0

Course Objectives

To impart knowledge on

- Understanding the problems associated with hard water and treatment methods.
- Thermodynamic concepts and energy resources
- The importance of corrosion control methods
- Polymers and types and applications of Materials

Course Outcomes

The students will be able to

- Get a compendium of applicable knowledge on Chemistry
- Understand the Hard Water Treatment methods
- Apply the knowledge of thermodynamics and Electrochemistry concepts
- Utilize the knowledge of advanced materials

Course Description:

Hard Water – Estimation and softening methods – Desalination and Municipal water treatment methods – Chemical Thermodynamics - Definitions – Thermodynamic processes – Laws of thermodynamics – Relation between Cv and Cp – Gibbs-Helmholtz equation – Electrochemistry – Nernst equation – Electrochemical cells – Batteries and fuel cells – Electrochemical sensors - Corrosion – Polymers – Synthetic and Natural – Properties and applications – Moulding constituents – Fabrication –Advanced materials –Nanomaterials – Types - Applications – Photo voltaic cells – Design and working.

Reference Books

1. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.
2. Engineering Chemistry – A Text book of Chemistry for Engineers Wiley India Pvt. Ltd, 2012.
3. Jain P. C, Monica Jain, A Textbook of Engineering Chemistry, Dhanpat Rai Publications, New Delhi, 16th edition, 2008.
4. M.A. Shah, Principles of Nanoscience and Nanotechnology, Narosa Publishing House, New Delhi, 2011.

5. Peter Atkins; Julio de Paula, Physical Chemistry, 9th Edition Oxford University Press, New York, 2009

16CH1002 APPLIED CHEMISTRY FOR ENGINEERS

Credits: 3:0:1

Objectives

The course aims to impart knowledge on

- Various types of bonding interactions
- Water Purification Processes
- Role of polymer in engineering applications
- Effect of additives in food and Health
- Need for alternative energy and nanochemistry

Outcome

At the end of the course, the student will learn

- About the chemistry of factors affecting the quality of water, food and health
- The importance of polymers in various fields and corrosion control methods
- About the significance of clean energy and nanochemistry

Chemical bonding and interactions – Relative energy – Requirement of water treatment – Parameters – Process - Surfactants - Micelle formation – Classification of Polymers - Industrial and ecofriendly Polymers –- Chemistry of Food and for better health - Free radicals - Molecules of emotions – Electrode potential – Batteries and Supercapacitors - Fuel cells – Corrosion - Prevention of Corrosion - Peaceful uses of Chemistry –Weapons of destruction –Nanochemistry – Evolution - Top down and bottom up approaches – Classification - Applications – Nanopollution

References

1. Jain P. C, Monica Jain, A Text Book of Engineering Chemistry, Dhanpat Rai Publications, New Delhi, 16th Edition, 2008.
2. M.A. Shah and T.Ahnmed, "Principles of Nanoscience and Nanotechnology" , Narosa Publishing House, New Delhi, 2010.
3. Grace Ross Lewis, "1001 Chemicals in Everyday Products", John Wiley and Sons, 3rd Edition, 2001.

Experiments (Any Ten Experiments)

1. Determination of Hardness in water
2. Determination of dissolved oxygen in water
3. Estimation of Alkalinity in water
4. Estimation of iron in water by spectrophotometry
5. pH based experiment by pH Meter
6. pH based experiment using conductivity bridge
7. Softening of water by ion exchange method
8. Estimation of Iodine in iodized salt
9. Estimation of Calcium in milk powder
10. Synthesis of Aspirin
11. Analysis of Milk Adulteration
12. Analysis of oil
13. Calorie measurement
14. Estimation of Fe^{2+} by potentiometry
15. Estimation of copper in alloy
16. Synthesis of nanoparticles

16CH2001 CHEMICAL BONDING AND CONCEPTS OF ACIDS AND BASES

Credits : 3:0:0

Course Objectives:

- To impart knowledge about various kinds of bonding in inorganic chemistry.
- To impart the concepts of acids and. bases

Course outcomes:

The Students will

- Understand the basics of bonding interactions
- Have a clear understanding of acid base theory.

Course Description:

Types of Bonds – Ionic bond – Radius ratio – Ionic compounds of type AX, AX2 – Defects - Born Haber cycle – Covalent bond- Lewis theory -VSEPR Theory-VB theory – σ and π bonds - MO theory- LCAO method – Diatomic molecules- Hydrogen Bond and other weak interactions - Applications - Acids and Bases - Bronsted Lowry and Lewis theory - Hard and Soft acids and bases - Allotropy of Carbon- Silicates – Silicones - Applications.

Reference Books:

1. Lee J. D, "Concise Inorganic Chemistry", Wiley India (P.) Ltd, New Delhi, India, 5th edition, Reprint 2009.
2. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
3. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
4. W. H. Madan, G. D. Tuli, R. D.Madan, "Selected Topics in Inorganic Chemistry", S. Chand & Company Ltd, Reprint 2009.

16CH2002 ORGANIC REACTION INTERMEDIATES AND STEREOCHEMISTRY

Credits: 3:0:0

Objective:

- To impart basic understanding about reaction intermediates
- To illustrate the concepts of electronic effects
- To highlight the importance of stereoisomerism and conformation

Outcome:

The students will get

- The understanding on the structural basics of organic compounds and their reactions
- Knowledge on the reactions of carbonyl and nitrogen containing compounds

Course Description:

Classification and Nomenclature of organic compounds – Electrophiles and nucleophiles – Carbocation and Carbanion, Free radicals, Arynes - Inductive effect and field effect – Hyperconjugation – Tautomerism – Aliphatic and Aromatic nitrogen containing compounds – Aliphatic and Aromatic carbonyl compounds - Stereoisomerism – Cis-trans isomerism – E, Z nomenclature – Optical isomerism – Absolute configuration – R, S nomenclature – Cahn, Ingold, Prelog nomenclature – Conformation of ethane and cyclohexanes

Reference Books:

1. Michael B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 7th edn., Wiley Student Edition, John Wiley & Sons Asia Pvt. Ltd., March 2013.
2. R.T. Morrison & R.N. Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt Ltd., Singapore, 2003
3. P.S. Kalsi, Stereo Chemistry Conformation and Mechanism, New Age Publishing Ltd., New Delhi, 2002.
4. Bhupinder Mehta, Manju Mehta, Organic Chemistry, Prentice Hall of India private ltd., New Delhi, 2008.
5. I.L. Finar, Organic Chemistry, Pearson Education Pvt. Ltd., Vol. I & II, 6th Edition, Singapore,2002
6. F. A. Carey & R. J. Sundberg. Advanced Organic Chemistry, Part A and B, Springer; 5th edition (May 27, 2008)

16CH2003 ATOMIC STRUCTURE, THERMODYNAMICS AND ELECTROCHEMISTRY

Credits: 3:0:0

Objective:

To illustrate

- The basics of Quantum Chemistry
- The principles of chemical thermodynamics and electrochemistry
- The importance of Phase Rule

Outcome:

The student will be able to

- Understand the importance of Quantum Chemistry
- Know the importance of Thermodynamics and Electrochemistry
- Understand the significance of Phase rule

Course Description:

Atomic Structure –- Quantum Theory of Radiation – Photoelectric effect – Bohr Theory – Dual Character of Electron – Heisenberg Uncertainity Principle – Quantum Mechanics – Postulates - Schrodinger equation – Quantum Number - First Law of Thermodynamics – Heat Capacity – Second Law – Entropy - Chemical Equilibrium – The Vant Hoff reaction isotherm – LeChatlier Principle – Electrochemistry – Specific, Equivalent and Molar Conductances – Kohlraush Law – Applications – Electrode Potential – Nernst Equation – Applications -Phase Rule – Gibbs Phase Rule –One component Systems - Triple point

Reference Books:

1. B.R. Puri, L.R. Sharma and Madan S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., Jalandhar, 2008
2. Peter Atkins, "Elements of Physical Chemistry", OUP Oxford, 6th edition, 2012
3. Samuel H. Maron and Carl F. Prutton, "Principles of Physical Chemistry", fourth edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, reprinted in 2009
4. Un Dash, Op Dharmarha and P.L. Soni, "Text book of Physical Chemistry", Sultan Chand & Sons, New Delhi, 2011
5. A.K Chandra, "Introduction to Quantum Chemistry", Tata McGraw Hill, New Delhi, 1997 (recent edition)
6. J. C. Kuriacose and J.Rajaram, "Thermodynamics for students of chemistry", 3rd Edition, Shoban Lal Nagin Chand & Co., Jalandhar, 1999 (recent edition)
7. Samuel Glasstone, "An introduction to electrochemistry" Atlantic Publishers, 2007

16CH2004 CHEMISTRY OF TRANSITION AND INNER-TRANSITION ELEMENTS

Credits:3:0:0

Course Objectives:

- To impart knowledge about transition metal inorganic chemistry.
- To explain the various theories of coordination chemistry.
- To illustrate the importance of f-block elements and their applications

Course outcomes:

The students will

- Know the properties of transition metal compounds.
- Understand the theory behind the formation of coordination complexes
- Know the importance of inner transition elements

Course Description:

Transition metals –Color and magnetic properties - Coordination compounds – Nomenclature – Ligands - Isomerism – Werner's theory – Shapes of d orbitals – Valence bond Theory – Crystal Field theory – Coordination Geometries - Effect of crystal field splitting - Jahn-Teller distortion – Charge Transfer Transition – Stability - Chelate and macrocyclic Effects- Organometallic Chemistry - Ferrocene - Catalysts– Zeigler Natta Catalyst – Inner transition elements - Electronic and Magnetic properties - Lanthanide contraction

Reference Books:

1. Lee J. D, "Concise Inorganic Chemistry", Wiley India (P.) Ltd, New Delhi, India, 5th edition, Reprint 2009.
2. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
3. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
4. W. H. Madan, G. D. Tuli, R. D.Madan, "Selected Topics in Inorganic Chemistry", S. Chand & Company Ltd, Reprint 2009.

16CH2005 – REACTION MECHANISM AND HETEROCYCLIC CHEMISTRY

Credits: 3:0:0

Objective:

- To discuss various types of reaction mechanisms
- To introduce the chemistry of heterocyclic compounds

Outcome:

- Get a thorough knowledge on organic reaction mechanisms
- Get knowledge on the preparation and properties of heterocycles

Course Description:

Substitution reactions – Aliphatic nucleophilic - S_N1 and S_N2 mechanisms – Aromatic nucleophilic - S_NAr mechanism – Benzyne mechanism – Aliphatic Electrophilic - S_E1 and S_E2 mechanisms – Aromatic Electrophilic - Arenium ion mechanism – Neighboring group participation - Hammett equation - Elimination reactions – E_1, E_2 mechanisms - Addition reactions – Heterocyclic Chemistry – One hetero atom - Pyrrole, Furan, Thiophene – Two hetero atom – Pyrazole, Imidazole, Thiazole – Reactions and properties.

Reference Books:

1. Michael B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 7th edn., Wiley Student Edition, John Wiley & Sons Asia Pvt. Ltd., March 2013.
2. F. A. Carey & R. J. Sundberg. Advanced Organic Chemistry, Part A and B, 5th edition (May 27, 2008)
3. R.T.Morrison & R.N.Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt Ltd., Singapore, 2003
4. S. H. Pine, Organic Chemistry, 5th edn., McGraw-Hill, 1987
5. Raj.K. Bansal, "Heterocyclic Chemistry", New Age International Publishers, 4th Edition, Reprint, 2009.

16CH2006 SURFACE CHEMISTRY AND CHEMICAL KINETICS

Credits: 3:0:0

Objective:

- To illustrate the fundamental properties of liquid state and liquid crystals
- To impart the knowledge on the principles of colloidal state and surface chemistry
- To demonstrate the significance of kinetics and Catalysis

Outcome:

The students will understand

- The basics of Liquid state and Liquid Crystals
- The importance of Colloidal substances and surface chemistry and their applications
- The importance of Kinetics and Catalysis

Course Description:

Liquid State – Properties – Surface Tension – Surface Energy – Liquid Crystals – Thermotrophic and Lyotrophic – Vapor Pressure – Temperature Diagram – Colloidal State – Types and Properties – Sols - Electrophoresis – Electro-osmosis – Emulsion – Gels – Surfactants –Micelles – Adsorption – Types – Langmuir, Freundlich and BET Isotherms – Techniques for Investigating Surfaces – Elementary Treatment – Kinetics – Order and Molecularity – First and Second Order Reactions – Arrhenius Equation – Catalysis – General Characteristics – Types – Enzyme Catalysis

Reference Books:

1. B.R. Puri, L.R. Sharma and Madan S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., Jalandhar, 2008
2. Peter Atkins, "Elements of Physical Chemistry", OUP Oxford, 6th edition, 2012
3. Samuel H. Maron and Carl F. Prutton, "Principles of Physical Chemistry", fourth edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1965 (reprinted in 2009)
4. I.N. Levine, "Physical Chemistry", 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007
5. Un Dash, Op Dharmarha and P.L. Soni, "Text book of Physical Chemistry", Sultan Chand & Sons, New Delhi, 2011
6. K.J. Laidler, "Chemical Kinetics", 3rd Edition 1997, Benjamin-Cummings. Indian reprint – Pearson, 2009
7. A.W. Adamson, "Physical Chemistry of Surfaces", 5th edition, Wiley, 1997 (recent edition)

16CH3001 RESEARCH METHODOLOGY

Credits: 3:0:0

Course Objective:

- To equip the students to undertake thorough literature survey
- To impart knowledge on scientific writing and scientific communication.
- To create an awareness about the good lab practices and scientific ethics.

Course Outcome:

The student will be able to

- Understand the principle of literature survey
- Prepare scientific reports
- Follow good lab practices and scientific ethics

Course Description:

Literature survey – Chemical abstracts – Dictionary of compounds — Chemical databases – Chemoinformatics and Data mining -Hand books – Lab data management – Documentation – Scientific honesty – Scientific ethics - Journals and other form of publications – Impact Factor and Citation Index – Report writing and preparation of thesis – Technical writing – Article writing – Scientific communication - IPR - Good Lab Practices - Chemical Lab safety – Storage, handling and disposal of hazardous chemicals and radioactive materials – MSDS – Safety measures during emergency – Encountering accidents

Reference Books

1. C. R. Kothari, Research Methodology: Methods & Techniques,New Age International Publishers, 3rd Edition, 2013
2. R. Panneerselvam, Research Methodology, PHI learning Pvt. LTD, 2014
3. J. R. Dean, A.M. Jones, D. Holmes, R. Reed, J. Weyers and A Jones, Practical Skills in Chemistry, 2nd Edition Prentice Hall, 2011.
4. F Abdul Rahim Thesis writing: Manual For all Researchers, New Age International 2007
5. Margret Cargill, Patrick O'Connor Writing Scientific Research Articles: Strategy and Steps, Wiley 2009.
6. Benjamin, Hazardous Waste Management: Reducing the Risk, Goldman Press 2013
7. A. Keith Furr, CRC Handbook of Laboratory Safety, 5thEdition, CRC Press 2000 b
8. Andre Picot, P. Grenouillet. Safety in the Chemistry and Biochemistry Laboratory, Wiley-VCH, 1995.
9. Dr. Kristin Shrader-Frechette, Ethics of Scientific Research, Rowman & Littlefield Publishers, 1994

16CH3002 MOLECULAR AND MATERIALS SELF ASSEMBLY

Credits: 3:0:0

Objective:

- To explain the formation of self assembly in nanomaterials
- To distinguish molecular and materials self-assembly

Outcome:

- Able to understand the forces behind the formation of self assembly in nanomaterials
- Have the knowledge on the bottom-up approach based on self assembly

Course Description:

Self-assembly – Molecular vs Material Self Assembly – Hierarchical Assembly – Directing Self Assembly - Self-assembled monolayers – Soft lithography – SAM Registration - Layer–by–layer (LbL)

self assembly – Electrostatic Superlattices – Organic Polyelectrolyte Multilayers – LbL MEMS, LbL films, LbL assembly- Non-Electrostatic Layer by Layer Assembly - Nanorod, Nanotube, Nanowire self-assembly - Nanocluster self-assembly - Self-assembling block copolymers

References:

1. G. A. Ozin and A. C. Arsenault, "Nanochemistry: A chemical Approach to nanomaterials" RSC Publishing, 2005
2. Zhong Cao G, "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", Imperial College Press, London, United Kingdom, 2004.
3. Nanochemistry, G.B. Sergeyev, Elsevier, 2007.
4. Core Concepts on supramolecular chemistry and nanochemistry, Jonathan Steed, Wiley Eastern Publishers, 2006
5. Nano: The essentials, T. Pradeep, McGraw Hill Publishers, 2007.
6. Supramolecular chemistry –Fundamentals and applications advanced textbook, Katsuhiko Ariga · Toyoki Kunitake, Springer-Verlag, 2000.
7. D. Vollatah,, Nanomaterials: An Introduction to Synthesis, Properties and Applications, springer, 2011.

LIST OF SUBJECTS

Sub Code	Name of the Subject	Credits
15CH2001	Polymer Science and Technology in Medicine	3:0:0
15CH2002	Bio-Ceramic Materials in Medicine	3:0:0
15CH2003	Chemistry in Everyday Life	3:0:0
15CH3001	Chemical Kinetics and Photochemistry	3:1:0
15CH3002	Chemical Bonding and Nuclear Chemistry	3:0:0
15CH3003	Organic Reaction Mechanism and Stereochemistry	3:1:0
15CH3004	Quantum Chemistry and Group Theory	3:1:0
15CH3005	Coordination Chemistry	3:1:0
15CH3006	Molecular Spectroscopy	3:0:0
15CH3007	Chemical Thermodynamics and Electrochemistry	3:0:0
15CH3008	Organometallic, Bioinorganic and Solid State Chemistry	3:1:0
15CH3009	Synthetic Methodology and Natural Products	3:0:0
15CH3010	Qualitative and Quantitative Inorganic Analysis Lab	0:0:4
15CH3011	Qualitative and Quantitative Organic Analysis Lab	0:0:4
15CH3012	Physical Chemistry Lab	0:0:4
15CH3013	Modern Instrumental Analysis Lab	0:0:2
15CH3014	Preparative Inorganic Chemistry Lab	0:0:2
15CH3015	Synthetic Organic Chemistry Lab	0:0:2
15CH3016	Instrumental Methods of Analysis	3:0:0
15CH3017	Main Group Chemistry	3:0:0
15CH3018	Synthetic Reagents and Concerted Reactions	3:0:0
15CH3019	Spectroscopic Methods for Structural Elucidation	3:0:0
15CH3020	Supramolecular Chemistry and Green Chemistry	3:0:0
15CH3021	Applied Electrochemistry	3:0:0
15CH3022	Materials Chemistry	3:0:0
15CH3023	Biomolecular Chemistry	3:0:0
15CH3024	Organotransition Metal Chemistry	3:0:0
15CH3025	Cheminformatics	3:0:0
15CH3026	Environmental Electrochemistry	3:0:0
15CH3027	Molecular Machines and Materials	3:0:0
15CH3028	Self Organization and Self-assembly in Nanostructures	3:0:0

15CH2001 POLYMER SCIENCE AND TECHNOLOGY IN MEDICINE

Credits: 3:0:0

Course Objective

- To enlighten the basic understanding of polymers and composites
- To impart knowledge on processing and the fabrication of polymeric materials
- To acquire knowledge on the bio-medical applications of polymers and its composites

Course Outcome

- Students would be familiar with the fundamental concepts and technology of polymer
- They would also acquire the knowledge on polymeric nano-composites
- They would be able to formulate and develop the polymer composite materials for bio-medical applications

Course Description:

Basic concepts of polymer – selection of monomers - classification and structure property relationship of polymers - polymer solutions - Principles of polymerization – polymerization techniques – Polymer characterization – microstructure, thermal and elastic behavior -Compounding and fabrication of polymer – polymer testing – Polymer composites and its types – filler matrix interaction in conventional composites – Introduction and applications of polymer nano-composites - Various types of polymeric materials - biogradable polymers, biomedical polymers, conducting polymers - Limitations of polymeric materials

Reference Books :

1. V R Gowariker, N V Viswanathan and Jayadev Sreedhar, Polymer Science, New Age International Publishers, New Delhi 2008.
2. Arie Ram, Fundamentals of Polymer Engineering (Kindle Edition) Springer 1997.
3. K. Holmberg, B. Jonsson, B. Kronberg, B. Lindman, Surfactants and Polymers in Aqueous Solution Wiley 2004.
4. John D. Wright, Nico A.J.M. Sommerdijk Sol-Gel Materials: Chemistry and Applications CRC 2000
5. Takashi Kato Liquid Crystalline Functional Assemblies and Their Supramolecular Structures Structure and Bonding, Springer 2008
6. Lyklema J, Fundamentals of Interface and Colloid Science –Academic Press, Vol- 4 Acedmic press 2005
7. Martin Prutton Introduction to Surface Physics –, Oxford University Press (1994).
8. KiichiTakemoto, Raphael M. Ottenbrite, and MikiharuKamachi Functional Monomers and Polymers, Second Edition ,CRC 1997.
9. George Odian Principles of Polymerization Wiley-Interscience; 4 edition 2004 .
10. J. Kahovec .I.meisel ,C.S.Kniep Polymers in Medicine Wiley VCH 2001

15CH2002 BIO-CERAMIC MATERIALS IN MEDICINE

Credits: 3:0:0

Course Objectives :

- To teach the fundamentals of various bio-materials
- To impart knowledge on processing and application of ceramic materials, bioactive glasses and glass ceramic materials
- To highlight the knowledge on bio-coatings and its relevance in medical field

Course Outcome :

- The students would understand various applications of ceramic materials in the medical field.
- The students would be able to formulate and fabricate various bio-ceramic materials for bio-medical applications
- To have a complete knowledge about the various calcium phosphates based ceramic materials along with the preparation, properties and applications.

Course Description :

Materials in medicine: Implant areas – dental, orthopedic. Implant materials – Body reaction to the implant materials – Chemistry of calcium phosphate bio ceramics – Calcium phosphate bone cements – Surface active glasses, bioactive glass – interfacial bonding - High strength bioactive glass ceramics – Bioactive Composites - Importance of bioactive coatings. Hydroxyapatite coated metal implants – coating methods, characterization and properties.

Reference Books :

1. Yamamura T, Hench L.L and Wilson J, CRC Handbook of Bioactive Ceramics, Vol. I & II, CRC Press, Boca Raton, 1990.
2. Park J.B, Biomaterials: An Introduction, Plenum Press, New York, 1979.
3. Bonfield V, Hastings C.H and Tanner K.E (eds.), Bioactive Ceramics, Vol4, Butterworth – Heinemann Ltd., Oxford, 1991.
4. Hans Bach, Low Thermal Expansion Glass Ceramics, Springer, 1995.
5. Hench L.L and Ethridge E.C, Biomaterials: An Interfacial Approach, Academic Press, New York, 1982.18
6. Joon Park, Bioceramics-Properties, Charactersization and Applications, Springer Publications,2008
7. Tadashi Kokubo, Bio-Ceramic & Their Applications, Woodhead Publications,2008
8. BikramjltBasu, Dhirendra, S.Katti, Ashok and A Joham, Advanced Biomaterial, Fundamentals, Processing and Applications, Wiley & Sons Inc,2009
9. HeimoO.Ylaner, Bioactive Glasses - Materials, Properties and Applications, Woodhead Publishing Materials, 2011.

15CH2003 CHEMISTRY IN EVERYDAY LIFE

Credits: 3:0:0

Course Objectives :

- To introduce to the students about the chemistry connections of everyday life.
- To relate what the student studies in the subjects to practical life.

Course Outcome :

- The students will know the practical aspects of chemistry in day-to-day life.
- The students will think innovative and develop application oriented products.

Course Description:

Drugs and Diseases-Causes, Sign and Symptoms of Polio, Diabetes, AIDS, Cancer- Vaccination-Protein Misfolding and disease-–Banned Drugs and its effect-Structure based Antibiotics and Antipyretics, Common drugs-Chemistry of Paints, Ice cream, Explosives, Hair dye- Advantages and Disadvantages with structure of monoglutamate (Aginomotto), Caffeine and Theobromine (in chocolates), Docosahexanoic acid (in fish), Alpha tocopherol (in body lotions), Aspartame (Artificial Sweetener)- Chemical Phenomena-Seashells vary in color- Water does not relieve the burning sensation of chilly-Sniffing dogs detect explosives and bombs-Flesh of Fish smells different from other meat-Cotton is highly water absorbent but dries slowly-Food adulteration-Fast food and organic food-Cholesterol (LDL and HDL)- Molecules of Emotion (Adrenaline, Dopamine, Epinephrine, Serotonin, and Oxytocin).

Reference Books:

1. Karukstis K.K., and Hecke G.R.V., "Chemistry connections: the chemical basis of everyday phenomena" Elsevier Science and Technology books, 2nd edition, 2003.
2. Grace Ross Lewis, "1001 Chemicals in everyday products", John Wiley and sons, 3rd edition, 2001.
3. www.listverse.com/2007/10/04/top-10-incurable-diseases/
4. www.bama.ua.edu/
5. www.foodproductdesign.com
6. www.angelfire.com/linux/chemistryofpaint/
7. www.ssrsi.org/sr1/weapon.explode.htm
8. Paul Engel, "Pain-free Biochemistry", Wiley – Blackwell publishers, 2009.

15CH3001 CHEMICAL KINETICS AND PHOTOCHEMISTRY

Credits: 3:1:0

Course Objectives :

- To understand the Dynamics of Chemical Kinetics, Catalysis, Surface Chemistry & Photochemistry.

Course Outcome :

- Students will acquire a good knowledge on the chemical kinetics, unimolecular and bimolecular reactions, fast reactions, Catalysis, Surface chemical reactions and Photochemistry of atoms and molecules.

Course Description :

Rate law – Kinetics of rate equations - Complex and Fast reactions – Collision theories – Arrhenius theory of reaction rates – Theory of absolute reaction rates – Study of kinetics of stopped flow techniques – Flash photolysis – Shock tubes – Kinetic isotope effects – Hammett relationship – Taft equation – Related Problems - Acid – Base catalysis – Enzyme catalysis – Theory and applications – Mechanism of heterogeneous catalysis - Adsorption of gases by solids – Langmuir, Freundlich and BET isotherms – Absorption and emission of radiation – Theories Laser – Franck Condon principle – Physical properties of electronic excited state – Resonance emission – Photosensitization and Chemiluminescence – Chemical actinometry - Problems

Reference Books :

1. Laidler K.J., "Chemical Kinetics", Harper and Row, New York, 3rd Edition, 2008.
2. Rajaram J & Kuriakose, J.C., "Kinetics and mechanism of chemical transformation", McMillan India Ltd., New Delhi, 2011.
3. Adamson, A.W.,"Physical Chemistry of Surfaces", Wiley, 6th edition, 1997.
4. Rohatgi Mukherjee K. K., "Fundamentals of photochemistry", New Age International Pvt. Ltd., New Delhi, 2009.
5. Atkins P.W., "Physical Chemistry", Oxford University Press, 8th edition, 2006.
6. Kalidas, C. "Chemical Kinetic Methods: Principles of Relaxations Techniques and application", New Age International (P) Ltd, Chennai, 2005.
7. Levine I.N., "Physical Chemistry", Tata Mc Graw Hill, NY, 2007.

15CH3002 CHEMICAL BONDING AND NUCLEAR CHEMISTRY

Credits: 3:0:0

Course Objectives :

- To explain the theory of acids and bases and non-aqueous solvents.
- To discuss the various types of chemical bonding.
- To discuss nuclear chemistry and their application in various fields.

Course Outcome :

- Students will have thorough knowledge of theory of acids and bases
- The students will understand the theories of chemical bonding.
- The students will know the importance of nuclear chemistry and its applications

Course Description :

Periodicity - Bronsted and Lewis acids and Bases – HSAB – Non-aqueous Solvents - Leveling Effect – Liquid Ammonia – Sulfuric acid – Hydrofluoric Acid – Sulfur dioxide – Dinitrogen tetroxide - Ionic Bonding – Lattice energy –Born Lande Equation – Born Haber Cycle – Fajan's rule – Limiting Ratio – Covalent Bond – VB Theory – Hybridization – MO Theory of Diatomic Molecules – VSEPR Theory – Fluxionality – Ion-dipole Interaction – Hydrogen Bonding — Nuclear Stability – Nuclear Fission – Nuclear Fusion – Radioactive Detectors - Nuclear Reactions - Neutron Activation Analysis – Carbon and Rock Dating –Applications of Tracers

Reference Books:

1. Lee J. D, "Concise Inorganic Chemistry", Wiley India (P.) Ltd, New Delhi, India, 5th edition, Reprint 2009.
2. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
3. Sharpe A.G. "Inorganic Chemistry", Dorling Kindersley (India) Pvt. Ltd, 2nd impression, 2008.
4. Satyaprakash, Tuli G. D, Basu S. K & Madan R. D, "Advanced Inorganic Chemistry" Vol I and II, S. Chand and Company Ltd, NewDelhi, India, Reprint: 2009.
5. Mido Y, Taguchi S, Sethi M.S & Iqbal S. A, "Chemistry in Aquous and Non-aqueous Solvents", Discovery Publishing House, New Delhi, 2003
6. Arnikar H. J, "Essentials of Nuclear Chemistry", New Age International Publishers Ltd., New Delhi, India, 4th edition, 2007.

15CH3003 ORGANIC REACTION MECHANISM AND STEREOCHEMISTRY

Credits: 3:1:0

Course Objectives :

- To enable the student to understand the stereochemistry of organic reactions
- To explain the mechanism and molecular rearrangements of organic reactions.

Course Outcome :

- Students can carry out organic reactions with proper understanding and knowledge of mechanism and orientation changes.

Course Description :

Inductive, electromeric and resonance effect - Hyperconjugation - Reactive intermediates- Generation, stability & reactions of Carbanions - Carbocation – Carbenes – Nitrenes - Radicals and Ylids – Aromaticity - Nucleophilic and electrophilic substitution Reactions - Additions to multiple bonds - Elimination reactions - Principles of stereochemistry, Conformational analysis, isomerism and chirality - Projection structure of stereoisomers – Fischer and Newmann – DL, RS and EZ notations - Stereoselectivity and stereospecificity - Problems

Reference Books :

1. Jerry March, "Advanced Organic Chemistry", Wiley Eastern Limited, New Delhi, 4th edition, 2008.
2. Bahl. B.S. and Arun Bahl, "A Text book of Organic Chemistry", S. Chand & company Ltd., New Delhi, Reprint, 2011.
3. Peter Sykes, "A Guidebook to Mechanism in Organic Chemistry", Longman Press, London and New York, Reprint, 2006.
4. Ernest. L. Eliel, "Stereochemistry of carbon compounds", Tata-McGraw Hill, New Delhi, 22nd Reprint 2009.
5. Nasipuri. D. "Stereochemistry of organic compounds – Principles and applications", New Age international, 2nd edition, 2002.
6. Kalsi. P.S. "Stereochemistry Conformation and Mechanism", New Age International Publishers, New Delhi, 6th Edition, Reprint, 2005.
7. Finar. I.L., "Organic Chemistry, Volume 1", Doorling Kindersley (Indian), 6th Edition, 5th impression, 2008.
8. Raj K. Bansal, "Organic reaction mechanism", Tata McGraw Hill, New Delhi, 4th Edition, 2005.
9. Carey. F.A. "Organic Chemistry", McGraw Hill, Inc., 2nd edition, 1992.
10. Morrison and Boyd, "Organic Chemistry", United States of America, 3rd edition, 1992.
11. Carey, F.A, and Sundberg. R. J, "Advanced Organic Chemistry Part – A:, Plenum Press, 2007.

15CH3004 QUANTUM CHEMISTRY AND GROUP THEORY

Credits: 3:1:0

Course Objectives :

- To study the importance of quantum chemistry
- To understand the applications of group theory to atoms and molecules.

Course Outcome :

- Students acquire a good knowledge on the fundamentals of quantum chemistry and the practical applications of group theory.

Course Description :

The failures of classical mechanism –black body radiation – Uncertainty principle – Schrodinger equations – Harmonic oscillator – Rigid rotor – Angular momentum – Related Problems - Variation and perturbation theory – Slater detrimental wave functions – Born Oppenheiner approximation – LCAO, MO and VB treatments – Huckel theory of linear conjugated systems –Woodward Hoffman rules - Molecular symmetry and operations - Cartesian coordinate system - Properties of a group – Group Multiplication tables – Molecular point groups – Great orthogonality theorem and its applications – Symmetries of normal modes of vibration in non - linear molecules – Symmetry selection rules for vibrational spectra - M.O and electronic spectra – Hybridization schemes - Problems.

Reference Books :

1. Chandra, A.K. "Quantum Chemistry" Tata McGraw –Hill Pvt. Ltd., New Delhi, 4th Edition, 2002.
2. Donald A McQuarrie, "Quantum Chemistry", Viva Books, New Delhi, 2008.
3. Hanna, M.W., "Quantum Mechanics in Chemistry", Addition Wisley, London, 3rd edition, 1981.
4. Swarnalakshmi S. "A Simple Approach to Group Theory in Chemistry" Universities Press, 2009.
5. Raman, K.V. "Group theory and its applications to chemistry", Tata Mac Graw Hill, 2004.
6. Cotton F.A. "Chemical application of group theory", Wiley India Pvt. Ltd., New Delhi, India, 3rd edition, 2009.
7. Carter R.L., Molecular Symmetry and Group Theory, John Wiley & Sons, NY, 2005.

15CH3005 COORDINATION CHEMISTRY

Credits: 3:1:0

Course Objectives :

- To discuss the Bonding, Spectra, Magnetism and Reaction Mechanism in Coordination Chemistry
- To understand the importance of f-block elements and their applications

Course Outcome :

- The Students will understand the structure, bonding and reaction mechanism in coordination complexes
- The students will understand the chemistry of lanthanides and actinides

Course Description :

Ligands – Formation of Complexes – Bonding theories - VB Theory – Crystal Field Theory – CFSE – Factors Affecting 10Dq – MO Theory – Electronic Spectra – Term Symbols – Problems - Orgel Diagram – Tanabe Sugano Diagram – Jahn-Teller Effect – CT Spectra –Magnetic Properties – Isomerism - Chelate and Macrocyclic Effects – Stability Constant – Problems -Substitution in Square Planar and Octahedral Complexes – Trans Effect – Thermodynamic and Kinetic Stability – Outer and Innersphere Reactions – Marcus Theory –Nature of Bridging Ligand – Lanthanide Contraction – Separation of Lanthanides and Actinides - Transactinides

Reference Books:

1. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
2. Purcell K. F & Kotz J. C., "Inorganic Chemistry" Cengage Learning, New Delhi, India, Reprint, 2010.
3. Greenwood N. N. & Earnshaw A, "Chemistry of the Elements", Reed Elsevier India Private Ltd, Gurgaon, India, 2nd edition, Reprinted 2010.
4. Miessler G. L & Tarr D. A., "Inorganic Chemistry", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 3rd Edition, 2009.
5. Gopalan R, Ramalingam V, Concise Coordination Chemistry, Vikas Publishing House Pvt. Ltd, 2001
6. Cotton F. A & Wilkinson G, "Advanced Inorganic Chemistry", 6th edition, Wiley India (P.) Ltd, New Delhi, India, First Reprint 2007.
7. Jordan R. B, "Reaction Mechanisms of Inorganic and Organometallic Systems", Oxford University Press, New York, USA, 3rd Edition, 2007.
8. Satyaprakash, Tuli G. D, Basu S. K & Madan R. D, "Advanced Inorganic Chemistry" Vol I and II, S. Chand and Company Ltd, NewDelhi, India, Reprint: 2009.
9. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
10. Figgis B. N. & Hitchman M. A, "Ligand Field Theory and Its Applications", Wiley-VCH Verlag GmbH & Co, Weinheim, Germany, 2000.

15CH3006 MOLECULAR SPECTROSCOPY

Credits: 3:0:0

Course Objectives :

- To understand the principles of Molecular Spectroscopy
- To discuss the principles of Emission Spectroscopy
- To understand the importance of Mossbauer Spectroscopy

Course Outcome :

- Students will know the principles of Rotation, Vibration and Electronic Spectroscopy
- The students will know the importance of NMR and ESR Techniques.
- The students will know the principles of Mossbauer and Photoelectron Spectroscopy

Course Description :

Electromagnetic Radiation – Rotational and Vibrational spectroscopy of diatomic and polyatomic molecule – Principles - 3N-6(5) Rule - Fermi resonance – Raman Spectroscopy – Mutual exclusion principle – Electronic Spectroscopy of Diatomic and Polyatomic Molecule - Transition moment integral – Predissociation – Fluorescence Spectroscopy – Principles – Photoelectron Spectroscopy – UPS – XPS – Auger Electron Spectroscopy – NMR Spectroscopy – Theory – Relaxation Processes – 1H NMR – ESR Spectroscopy – g-factor - spectra of simple organic radicals and first row transition metals – zero field splitting– kramer's degeneracy - Mossbauer spectroscopy – Principles- Isomer Shift, Quadrupole effect and Hyperfine splitting

Reference Books :

1. Fundamentals of Molecular Spectroscopy. C. N. Banwell and E. M. McCash, Tata McGraw-Hill publishing.
2. Molecular Spectroscopy. I. N. Levine, Wiley Interscience Publication.
3. Drago R. S, Physical Methods for Chemists, 2nd Revised edition,n Saunders (W.B.) Co Ltd;
4. Molecular Spectra & Molecular Structure. G. Herzberg, Van Nostrand Reinhold Company
5. Satya Narayana D. N, "Vibrational Spectroscopy Theory and Applications", New Age International Publishers, New Delhi, 2004.
6. Satya Narayana D. N, "Electronic Absorption Spectroscopy and Related Techniques", Universities Press (India) Ltd, Hyderabad, 2001.
7. Lakowicz J. R, "Principles of fluorescence spectroscopy", Springer Science+Business Media, New York, USA, 3rd editon, 2006.
8. Principles of Ultraviolet Photoelectron Spectroscopy, J. W. Rabalais, John Wiley & Sons.
9. Satya Narayana D.N., "Magnetic Resonance Spectroscopy ESR, NMR, NQR", I. K. International, New Delhi, 2009
10. Graybeal J. D., Molecular Spectroscopy.,McGraw Hill.
11. Hollas J. M., Modern Spectroscopy. John Wiley & Sons.

15CH3007 CHEMICAL THERMODYNAMICS AND ELECTROCHEMISTRY

Credits: 3:0:0

Course Objectives :

- To know about classical & statistical thermodynamics.
- To understand the fundamental and applied concepts of electrochemistry

Course Outcome :

- Students acquire a good understanding of the basic principles of thermodynamics and electrochemistry.

Course Description :

Laws of thermodynamics and its limitation – Activity – Activity coefficient – Fugacity –Concepts of probability and Maxwell Boltzmann distribution – Relationship between entropy and thermodynamic probability systems with degeneracy – Sackur–Tetrode equation – The Bose–Einstein's and Fermi–Dirac statistics – Heat capacity of solids – Debye and Einstein models – Irreversible thermodynamics – steaming potential – the Dorn effect – Theories of electrical double layers – Electrode kinetics – Butler Volmer Equation - Hydrogen overpotential

Reference Books :

1. Atkins P.W., "Physical Chemistry", Oxford University Press, 8th edition, 2006.
2. Glasstone S., "Thermodynamics for Chemists", East West Press Pvt. Ltd., New Delhi, 2005.
3. Levine I.N., "Physical Chemistry", Tata Mac Graw Hill, NY, 2007.
4. N.D. Smith, "Elementary Statistical Thermodynamics", Plenum Press, New York, 1984.
5. Samuel Glasstone, "An Introduction to Electrochemistry", Maurice Press, 2007.
6. John O'M. Bockris, Amulya K. N. Reddy, "Modern Electrochemistry", Vol. I and II, Plenum Publishing, 2008.

15CH3008 ORGANOMETALLIC, BIOINORGANIC AND SOLID STATE CHEMISTRY

Credits: 3:1:0

Course Objectives :

- To discuss the Structure, Reactions and Catalysis in Organometallic Chemistry
- The Bioinorganic Chemistry of elements will be discussed
- To understand the importance of inorganic photochemistry and Solid State Chemistry

Course Outcome :

- The Students will understand the importance and applications of Organometallic chemistry, Bioinorganic Chemistry, Inorganic Photochemistry and Solid State Chemistry

Course Description:

18 Electron Rule – Problems - Chemistry of Metal carbonyl, Nitrosyl, Alkyl, Carbene, Carbyne, Allyl and Arene complexes - Metallocenes – Fluxionality – Reactions – Catalysis - Hydrogenation, Carbonylation, Hydroformylation, Wacker Process and Zeigler-Natta Catalysis – Inorganic Photochemistry - Photosubstitution and Photoredox reactions – Ligand Photoreactions – Ruthenium Polypyridine complexes – Solar energy Conversion – Essential and Trace elements in Biological Systems – Bioinorganic Chemistry of Fe, Co, Cu, Mn and Zn – Enzymes – Model Complexes - Platinum anticancer drugs – Biomaterials - Crystal Systems – Defects – Band Theory of Solids – Structures of Compounds of types AX, AX_2 and ABX_3

Reference Books:

1. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
2. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
3. Porterfield W. W, "Inorganic Chemistry A Unified Approach", Reed Elsevier India Private Ltd, Gurgaon, India, 2nd Edition, Reprinted 2009.
4. Purcell K. F & Kotz J. C., "Inorganic Chemistry" Cengage Learning, New Delhi, India, Reprint, 2010.
5. Cotton F. A & Wilkinson G, "Advanced Inorganic Chemistry", 6th edition, Wiley India (P.) Ltd, New Delhi, India, First Reprint 2007.
6. Gupta B. D & Elias A. J, "Basic Organometallic Chemistry", CRC Press, New Delhi, India, 2010.
7. Greenwood N. N. & Earnshaw A, "Chemistry of the Elements", Reed Elsevier India Private Ltd, Gurgaon, India, 2nd edition, Reprinted 2010.
8. K. Hussain Reddy, BIOINORGANIC CHEMISTRY, New Age International Ltd, 2003
9. Bertini I, Gray H. B, Lippard S. J & Valentine J. S, "Bioinorganic Chemistry", Viva Books Private Ltd, New Delhi, India, 2007.
10. West R, "Solid State Chemistry and its Applications", Wiley India Pvt. Ltd, New Delhi, India, 2007.

15CH3009 SYNTHETIC METHODOLOGY AND NATURAL PRODUCTS

Credits 3:0:0

Course Objectives :

- To enable the student to understand Modern Synthetic Methods using Reagents, Heterocycles and its allied natural products, (c) the modern methods for molecular fashions applied in pharmaceutical industry.

Course Outcome :

- Students will be aware of Heterocyclic compounds and its medicinal use; they will get the knowledge about the molecular fashions in the pharmaceutical industry through the modern reactions and reagents.

Course Description :

Modern Synthetic methods and reagents – Coupling Reactions – Reagents – NBS, DDQ, DCC, Gilmann Reagent - Introduction to multi-component reactions. Heterocyclic Nomenclature – Structure, Preparation, Properties and Reactions of Pyrazole, Imidazole, Pyridazine, and Pyrimidines. General Methods of Structure elucidation of Alkaloids, Terpenoids, Steroids, and anthocyanidines. Chemistry of Vitamins and Carbohydrates-Introduction to Amino acids, Proteins and Nucleic acids.

Reference Books:

1. Smith M. B., Organic Synthesis, 3rd Edition, Wave Functions Inc. 2010.
2. Carruthers, W.; Coldham, I. Modern Methods of Organic Synthesis, 04th Edition Cambride University Press, 2004.
3. Joule, J. A. and Mills K. Heterocyclic Chemistry, 05th Edition, Wiley, 2010.
4. Agarwal. O.P, "Chemistry of natural products, Vol.1 & 2", Goel publishing house, 36th Edition, 2009.
5. Raj.K. Bansal, "Heterocyclic Chemistry", New Age International Publishers, 4th Edition, Reprint, 2009.
6. Finar. I.L., "Organic Chemistry", Volume 2, Doorling Kindersley (Indian), 6th Edition, 5th Impression 2008.
7. Gurdeep R. Chatwal, "Organic Chemistry of Natural Products", Himalaya Publishing Home, New Delhi, 5th & Enlarged Edition, 2008.
8. Lehninger Principles of Biochemistry 5th edition, 2008 - Nelson, D. L. and M. M. Cox. (W. H. Freeman &Co.).
9. Organic Chemistry (5th Edn.) Robert. T.Morrison & N. Boyd. Hill edition.

15CH3010 QUALITATIVE AND QUANTITATIVE INORGANIC ANALYSIS LAB

Credits: 0:0:4

Course Objectives :

- To provide the students a competence in the laboratory skills required for accurate and precise chemical analysis.
- The students will know the theoretical basis of qualitative inorganic analysis containing common and less common ions.

Course Outcome :

- The student will gain the laboratory skills to estimate quantitatively by using complexometric and redox titrations
- The student can confirm the presence of less common and common ions in the mixtures using semimicro analysis.

Course Description :

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

Reference Books :

1. Mendham J., Denny R. C., Barnes J. D. and Thomas M. J. K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, Seventh impression 2008.
2. Ramanujam V. V., "Inorganic semimicro qualitative analysis", 3rd edition, The national publishing company, Chennai, India, reprinted 2008.
3. Svehla G., "Vogel's Textbook of Qualititative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, fifth impression 2008.

15CH3011 QUALITATIVE AND QUANTITATIVE ORGANIC ANALYSIS LAB

Credits: 0:0:4

Course Objectives :

- To enrich the knowledge of Organic Laboratory skills for estimation and analysis of Organic mixture.

Course Outcome :

- Students acquire the knowledge of estimation and analysis of Organic Compounds
- The student can characterize the unknown compound using functional group Analysis.

Course Description :

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

Reference Books:

1. A.I. Vogel – "Text book of practical organic chemistry", 5th Ed. ELBS, London, 1989
2. B.B. Dey and M.V. Sitharaman, "Laboratory manual of Organic Chemistry" Revised by T.R. Govindachari, Allied Publishers Ltd., New Delhi, 4th Revised edition, 1992
3. Daniel R. Palleros, "Experimental Organic Chemistry" John Wiley & Sons, Inc., New York, 2000
4. B.S. Fumiss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, "Text book of Practical Organic Chemistry", LBS, Singapore, 1994
5. S.M. Khopar, "Basic concepts of Analytical Chemistry", John Wiley & Sons, 1984
6. Gnanapragasam N.S., Ramamurthy G, "Organic Chemistry Lab Manual", revised edition, S. Viswanathan printers and publishers Pvt. Ltd., Chennai, Reprinted 2011.

15CH3012 PHYSICAL CHEMISTRY LAB

Credits: 0:0:4

Course Objective:

- To carryout simple chemical reaction which would be monitored by Electrical and Non-Electrical experimental studies.

Course Outcome:

- The analytical skill will be improved by pursuing electrical experiments like Conductometry, Spectrophotometry, Potentiometry.
- The basic knowledge could be understood thoroughly regarding the velocity of the reaction, distribution properties and adsorption studies.

Course Description:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

Reference Book

1. Svehla G., "Vogel's Textbook of Qualititative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, fifth impression 2008.

15CH3013 MODERN INSTRUMENTAL ANALYSIS LAB

Credits: 0:0:2

Course Objective:

- To carryout simple chemical reaction which would be monitored by Electroanalytical and Spectrophotometric Techniques

Course Outcome:

- The student will be exposed to various analytical techniques like Conductometry Potentiometry, Spectrophotometry and X-ray Diffraction

Course Description:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

Reference Book

1. Mendham J., Denny R. C., Barnes J. D. and Thomas M. J. K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th edition, Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, Seventh impression 2008.

15CH3014 PREPARATIVE INORGANIC CHEMISTRY LAB

Credits: 0:0:2

Course Objectives :

- To provide the students an appreciation for the preparation and Characterization of Inorganic Complexes.

Course Outcome :

- The student will gain the laboratory skills to prepare the inorganic complexes,
- The student will be able to characterize the inorganic complexes using IR and UV Spectroscopy

Course Description:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

Reference Books :

1. Gopalan R, Ramalingam V, Concise Coordination Chemistry, Vikas Publishing House Pvt. Ltd, 2001
2. Allcock, H, R.,"Inorganic Syntheses", Volume 25, John Wiley & Sons, New York, USA, 1989

15CH3015 SYNTHETIC ORGANIC CHEMISTRY LAB

Credits: 0:0:2

Course Objectives :

- Employ various reaction types to synthesize organic compounds and characterize them using Spectra.

Course Outcome :

- Understanding of the reaction conditions for various organic reactions
- The student can able to analyze the purity of the compound using Thin Layer Chromatography and interpret the spectroscopic data of the organic compounds

Course Description :

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

Reference Books :

1. A.I. Vogel – "Text book of practical organic chemistry", 5th Ed. ELBS, London, 1989
2. B.B. Dey and M.V. Sitharaman, "Laboratory manual of Organic Chemistry" Revised by T.R. Govindachari, Allied Publishers Ltd., New Delhi, 4th Revised edition, 1992
3. Daniel R. Palleros, "Experimental Organic Chemistry" John Wiley & Sons, Inc., New York, 2000
4. B.S. Fumiss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, "Text book of Practical Organic Chemistry", LBS, Singapore, 1994
5. S.M. Khopar, "Basic concepts of Analytical Chemistry", John Wiley & Sons, 1984

15CH3016 INSTRUMENTAL METHODS OF ANALYSIS

Credits: 3:0:0

Course Objectives :

- To understand the principles of Instrumentation Techniques
- To understand the applications of various analytical techniques

Course Outcome :

- Students will know the principles of various types of chromatographic techniques.
- The students will know the principles of Thermal methods, Atomic Spectroscopy and X-ray Diffraction.
- The students will know the application of instrumental techniques in various fields

Course Description:

Data Analysis – Principles of Titrations – Instrumental Techniques – Classification – Modern Analytical Techniques- Chromatography - Principles and applications of Liquid column, Solid/liquid, Liquid/liquid, Ion exchange, HPLC and Gas chromatography - Atomic absorption and emission spectroscopy- ICP-AES - X-ray diffraction Methods – Instrumentation — Diffraction pattern – Structure factor – Reliability factor - Applications – Surface Characterization Techniques – SEM - TEM - Thermal Methods - Water analysis - Food analysis - Body Fluid analysis - Process Instruments – Automation Strategy –Chemical Sensors – Automatic Chemical Analysers – Laboratory Robot

Reference Books:

1. Willard H, Merrit L, Dean J. A. & Settle F.A., "Instrumental methods of chemical analysis", CBS Publishers and Distributers Pvt. Ltd, New Delhi, 7th edition, 1986.
2. Skoog D. A, West D. M, Holler F. J & Crouch S. R, "Fundamentals of Analytical Chemistry", Cengage Learning India Pvt. Ltd, New Delhi, India, 8th Edition, 2004.
3. Day R. A.& Underwood A. L., "Qunatitative Analysis", 6th Edition, Printice Hall of India Pvt Ltd, New Delhi,2006
4. G.D. Chritiain. Analytical Chemistry Wiley
5. Srivatsava A. K. & Jain P. C, "Chemical Analysis", S. Chand Publications, New Delhi, 3rd edition, 1997.
6. Chatwal G. R & Anand S. K, "Instrumental Methods of Chemical Analysis", Himalaya Publishing House, Mumbai, India, 5th Edition, Reprint 2011.
7. **Valcarcel**, Miguel, Principles of Analytical Chemistry, Springer, 2000.
8. G. Sharma, B K Chaturvedi, Richard E. Wolfe, Basic Analytical Chemistry, DK publishers, 2011
9. Zhou W, Wang Z. L, "Scanning Microscopy for Nanotechnology: Techniques and Applications", Springer, New York, USA, 2006.
10. R.P. Braun,Introduction to Instrumental Analysis, McGraw Hill

15CH3017 MAIN GROUP CHEMISTRY

Credits: 3:0:0

Course Objective:

- To understand the structure and bonding in Main group Compounds
- The chemistry of Inorganic Polymers
- To understand the bonding in Inorganic cages and clusters

Course Outcome:

- The Students will understand the structure and bonding in main group Chemistry
- The students will know the importance of inorganic polymers
- The students will understand the structure and bonding in inorganic cages and clusters.

Course Description:

Alkali and alkaline earth metals - Crown ether complexes and cryptands – Compounds of Berylium - Polymorphism of Carbon, Phosphorus and Sulfur – Carbides – Silicates - Oxides and oxyacids of Se and Te - Interhalogens - Xenon compounds - Homocyclic inorganic systems - p□-p□ and p□-d□ bonding - Inorganic Polymers – Classification - Chemistry of B-O compounds and B-N compounds - Silicones, Polyphosphazene and (SN)x - Coordination Polymers - Metal-organic frameworks - Boron hydrides – styx numbers – Heteroboranes – Carboranes – Metal Clusters - d□-d□ bonding – Examples

Reference Books:

1. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
2. Greenwood N. N. & Earnshaw A, "Chemistry of the Elements", Reed Elsevier India Private Ltd, Gurgaon, India, 2nd edition, Reprinted 2010.
3. Purcell K. F & Kotz J. C., "Inorganic Chemistry" Cengage Learning, New Delhi, India, Reprint, 2010.
4. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
5. Cotton F. A & Wilkinson G, "Advanced Inorganic Chemistry", 6th edition, Wiley India (P.) Ltd, New Delhi, India, First Reprint 2007.
6. Driess M. & Nöth H, "Molecular Clusters of the Main Group Elements", Wiley-VCH Verlag GmbH & Co, Weinheim, Germany, 2004.
7. Chandrasekhar V, "Inorganic and Organometallic Polymers" Springer-Verlag Berlin, Heidelberg Germany, 2005
8. Henderson W, "Main Group Chemistry", Royal Society of Chemistry, United Kingdom, 2000.
9. Chivers T & Manners I, "Inorganic Rings and Polymers of the p-Block Elements", Royal Society of Chemistry, United Kingdom, 2009.
10. Archer R. D, "Inorganic and Organometallic Polymers", John Wiley and Sons, New York, USA, 2001.

15CH3018 SYNTHETIC REAGENTS AND CONCERTED REACTIONS

Credits 3:0:0

Course Objective:

- To enable the student to understand the principles of organic synthesis, Reagents used in organic synthesis (c) Photochemical, Pericyclic, and different Molecular rearrangements.

Course Outcome:

- Students can make use of different reagents in organic synthesis and they can do it in different pathways.

Course Description:

Organic name reactions and reagents based on Oxidation and Reduction - Pericyclic reactions - Electrocyclic, cycloaddition, sigmatropic, Chelotropic, Ene reactions – Photochemistry - Basic principles. Photochemistry of alkenes, carbonyl compounds, and arenes – Photo-oxidation and photo-reduction – Retrosynthesis – The disconnection approach – Synthons, One & Two group C-X and C-C disconnections, Functional group inter-conversion, transposition for Amino- and Alkene- Retro strategies.

Reference Books :

1. Stuart Warren, "Organic Synthesis – The disconnection approach" – A John Wiley and Sons, Ltd., 2nd Edition, reprint, 2010.
2. Jagadamba Singh and Jaya Singh, "Photochemistry and Pericyclic Reactions", New Age International Publishers, New Delhi, 3rd Revised Edition, Reprint, 2011.
3. Carey, F.A, and Sundberg. R. J, "Advanced Organic Chemistry Part – B: Reactions and Synthesis", Plenum Press, 2008.
4. Gurdeep R. Chatwal, "Reaction Mechanism and Reagents in Organic Chemistry", Himalaya Publishing House, New Delhi, 2007.
5. Finar. I. L, "Organic Chemistry", Volume 2, Doorling Kindersley (Indian), 6th Edition, 2008.
6. Hassner. A & Stumber. C, "Organic Synthesis based on name reactions", Pergamon Press, 2002.
7. Ahluwalia. V. K, and Rakesh Kumar Parashar, "Organic Reaction Mechanisms", Narosa Publishing House, New Delhi, 4th Edition, 2011.
8. Gilchrist. T. L, & Storr. R.C, "Organic reaction orbital symmetry", Cambridge university press, 1979.
9. Jerry March, "Advanced Organic Chemistry – Reactions, Mechanisms and structure", John Wiley & Sons, 4th Edition, 2008.
10. Mukherji. S. M, and Singh. S.P, Reaction Mechanism in Organic Chemistry, Macmillan Publishers, 3rd Edition, Reprinted, 2010.
11. Normon and Coxon J.M. Principals of Organic Chemistry, 3rd edition Chapmann and Hall 1993.
12. Coxon. J.M, and Halton. B, "Organic Photochemistry", Cambridge University Press, London, 1st Paper back edition, 2011.

15CH3019 SPECTROSCOPIC METHODS FOR STRUCTURE ELUCIDATION

Credits: 3:0:0

Course Objective:

- To apply the principles of Molecular Spectroscopy to Organic Molecules
- To Characterize the organic molecule using various spectroscopic technique
- To derive the structure of the molecule using the spectroscopic techniques

Course Outcome:

- Students will apply the principles of organic UV-Visible and IR spectroscopy
- To characterize Molecules using NMR and Mass spectrometry techniques
- The students will derive the structure of the organic molecule using the provided data

Course Description:

UV-visible spectroscopy -Woodward-Fieser rules - Principles of ORD and CD – Cotton effect – Octant rule – Axial haloketone rule –IR spectroscopy –– Fundamental vibrations and overtone - Finger print region – NMR Spectroscopy - Chemical shift - Spin-spin coupling –– Second order spectra -Simplification of complex spectra - NOE- ^{1}H-^{1}H COSY spectroscopy - ^{13}C NMR - Operating frequency – Decoupling –DEPT spectra –- Introduction to ^{19}F and ^{31}P spectroscopy - Mass spectrometry - Principles – Instrumentation – Molecular ion peak – Base peak –- Mclafferty rearrangement – Metastable ions – Structure Elucidation problems

Reference Books:

1. R. M. Silverstein, F. X. Webster, D. J. Kiemle, Spectrometric identification of organic compounds, 7th edition, John Wiley, 2005.
2. Organic Spectroscopy, W. Kemp, 3rd edition, Macmillan, 2011.
3. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, mcgraw Hill, 6th edition 2007.
4. D. L. Pavia and G. M. Lampman Spectroscopy 4th Edition, Brooks Cole, 2012.
5. P. S. Kalsi, Spectroscopy of Organic Compounds, 6th edition, New age international, 2004.

15CH3020 SUPRAMOLECULAR CHEMISTRY AND GREEN CHEMISTRY

Credits: 3:0:0

Course Objectives :

- The students will learn the supromolecular constructs of current importance.
- Information on concepts of modern chemistry which aids the students get motivated and prepared to do research after their masters.
- A knowledge on synthesizing and assembling molecular structures of different shapes and dimensions.

Course Outcome :

- The students will know the selectivity in formation of supramolecular chemistry and catalysis.
- They will understand the importance of green chemical pathways in reactions and their applications.

Course Description :

Definition – introduction to supramolecular chemistry – lock and key fit – induced fit model – chelate effect – binding constant: methods – kinetic and thermodynamic selectivity – host molecules – molecular self assembly – Macrocyclics vs. Acyclic hosts – molecular machines and switches – ladders, polygons, and helices – supramolecular catalysis – solid catalysts – pore diffusion – environmental catalysis – twelve principles of green chemistry – atom economy – supercritical carbon dioxide – water as solvent – solvent-free synthesis

Reference Books :

1. Jonathan Steed, David Turner, Carl Wallace, Core Concepts in Supramolecular and Nanochemistry, John Wiley & Sons, 2007.
2. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Second Edition, CRC Press, 2012.
3. I. Chorkendorff, J. W. Niemantsverdriet, Concepts of Modern Catalysis and Kinetics, Second Edition, Wiley-VCH Publishers, 2007

15CH3021 APPLIED ELECTROCHEMISTRY

Credits: 3:0:0

Course Objectives :

- Understand the basic concepts of electroanalytical techniques
- To gain familiarity with applications of electrochemistry
- Build confidence and knowledge to deal independently with electrochemical problems

Course Outcome :

- Students acquire a good knowledge on the fundamentals and applications of electrochemistry

Course Description:

Electodics – Transducers – Macro and Microelectrodes - Polarography – Tast Polarography – Cyclic Voltammetry – Normal pulse and Differential Pulse Voltammetry – Tafel Plot - AC Voltammetry – Impedance Spectroscopy - Spectroelectrochemistry - Corrosion – Theories of corrosion processes – Passivation of metals – Corrosion of monitoring methods and corrosion prevention - Electroplating of copper, chromium, zinc and gold – Anodizing – Electroforming – Electrocatalysis – Electrocatalysis in reactions involving absorbed species -– Lithium-ion batteries – Fuel Cells – Photoelectrochemical cells - Recent Advances

Reference Books :

1. Bard &. Faulkner, Electrochemical Methods: Fundamentals And Applications, Second Edition
2. Fritz Scholz, Electroanalytical Methods - Guide To Experiments And Applications, 2nd Ed, Springer-Verlag Berlin Heidelberg 2010
3. Joseph Wang, Analytical Electrochemistry, Third Edition 2006 John Wiley & Sons,
4. Vijay G. Singh, Applied Electrochemistry, Nova Science Publishers, 2010
5. John O'M Bockris, Amulya K. N. Reddy, Maria E. Gamboa-Adeco, "Modern Electrochemistry Vol.2 Part 1", Springer Science & Business Media, 2000
6. Raj Narayan, "An Introduction to metallic corrosion and its prevention", Oxford & IBH, 1983
7. Schlesinger, "Modern Electroplating", John Wiley, 2002
8. Jocek Lipkowski and Phil N. Ross, "Electrocatalysis", John Wiley & Sons, 1998
9. Thomas Reddy, "Linden's Handbook of Batteries" 4th Edition, McGraw-Hill, 2010

15CH3022 MATERIALS CHEMISTRY

Credits: 3:0:0

Course Objectives :

- To explain the synthesis, characterization and properties of materials.
- To demonstrate the applications of materials in various fields

Course Outcome :

- The students will get knowledge on the various types of materials and their synthetic strategy
- The student will understand the applications of material chemistry

Course Description :

Structure of Solids – Types – General Methods of Synthesis – Direct Synthesis – Solution Methods - Chemical Deposition – Transition Metal oxides – Metal nitrides – Chalcogenides - Characterization – Diffraction, Microscopic and Spectroscopic Techniques - Electrical, Optical and Magnetic properties – Carbon materials - Fullerenes - Application – Energy storage in solids – Catalysis – Porous materials - Recent Advances

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. B. Viswanathan, Structure and Properties of Solid State Materials, (2006), Narosa Publishing House Pvt. Ltd. New Delhi.
4. T. V. Ramakrishnan and C.N.R. Rao, Superconductivity Today, (1992) Wiley Eastern Ltd., New Delhi.
5. P. Ball, Designing the Molecular World: Chemistry at the Frontier, (1994) Princeton Univ. Press.
6. William D. Callister, Fundamentals of materials science and engineering, (2001) Ed. 5, John Wiley & sons.

15CH3023 BIOMOLECULAR CHEMISTRY

Credits: 3:0:0

Course Objectives :

- To discuss the structure and functions of biomolecules
- To understand the influence of biomolecules in bodily processes.
- The student will be exposed to separation and classification of large molecules.

Course Outcome :

- The students will get knowledge about the structure, properties and action of biomolecules.

Course Description :

Amino acids and Proteins - Structure, synthesis, separation and purification techniques - Nucleic acids – Purines – Pyrimidines – DNA – RNA - DNA Synthesis – Carbohydrates – Furanose- Pyranose – Glycoproteins - Proteoglycans - Fatty Acids - Lipids – Types – Enzymes – Classification - Catalysis - Mechanism And Kinetics, Metabolism - Reaction Pathways - Bioenergetics - Cellular Energy- Oxidation Of Carbon Fuels - Receptors - Metabolic Pathways - TCA Cycle - Mitochondrial Electron Transport Chain - Amino Acid Metabolism

Reference Books :

1. H.F. Gilbert, Basic concepts in biochemistry, , McGraw Hill, Ed. 2, 2002
2. David L. Nelson, Michael M. Cox, Lehninger's Principles of biochemistry, Ed. 4, 2002
3. J.M. Berg, J.L. Tymoczko, L. Stryer, Biochemistry, ,5th Ed, W.H. Freeman & Co., 2004
4. Lynne B. Jorde, Biochemistry notes, Kaplan Inc., 2002
5. G. N. Wilson, Biochemistry, McGraw Hill co., 2002

15CH3024 ORGANOTRANSITION METAL CHEMISTRY

Credits: 3:0:0

Course Objectives :

- To discuss the Structure and bonding in various transition metal organometallic compounds
- To understand the reaction mechanism in organometallic reactions
- To know the recent advances in Bioorganometallic Chemistry and the applications of catalysts in organic Synthesis and Polymer Chemistry

Course Outcome :

- The Students will understand the importance of organometallic chemistry,
- To use the organometallic catalysts in various fields.

Course Description :

18 electron rule – □-acceptor and □-donor ligands - M-M bond in bimetallic complexes – Reactions - Oxidative addition - □-bond metathesis – Insertion and Extrusion Reactions – Reactions of Coordinated Ligands – Synthesis and Properties of Metal carbonyls - Metal-alkyls and Metal-hydride complexes - Carbene and Carbyne complexes - □-Complexes of mono and polyenes – Sandwich complexes – Catalysis – Hydrogenation – Transformations of Alkenes and Alkynes – C-H activation and functionalization of alkanes and arenes – Carbonylation and carboxylation –- Heterogeneous Catalysis – Application in organic synthesis and Polymer Chemistry - Introduction to aqueous organometallic chemistry - Bioorganometallic Chemistry

Reference Books :

1. Didier Astruc, Organometallic Chemistry And Catalysis Springer-Verlag Berlin Heidelberg 2007
2. Robert H. Crabtree, Organometallic Chemistry of the Transition Metal, Wiley
3. Ferenc Joó, Aqueous Organometallic Catalysis, Kluwer Academic Publishers, 2002
4. Jiro Tsuji, Transition Metal Reagents and Catalysts: Innovations in Organic Synthesis. John Wiley & Sons, Ltd,2000
5. Roderick Bates, Organic Synthesis Using Transition Metals (Postgraduate Chemistry Series) – Wiley-Blackwell; 2nd Edition, 2012

15CH3025 CHEMINFORMATICS

Credits: 3:0:0

Course Objectives :

- The graphical way of representation of chemical structures will be discussed
- The Concepts of Molecular Descriptors and Structure - activity relationship will be dicussed
- Similarity Methods will be discussed

Course Outcome :

- The students gain knowledge on representation of chemical structures and the importance of QSAR and its use

Course Description :

Cheminformatics: Definition and scope – Representation of 2D molecular structures –Structure searching – Substructure searching – Reaction database - Representation of Patents – 3D representation – Experimental and theoretical 3D databases– 3D pharmacophores– Pharmacophore mapping – Applications – Molecular Descriptors – Descriptors calculated from 2D and 3D representations –Date verification and manipulation – Principal Component Analysis - Quantitative Structure-Activity Relationship – Deriving QSAR Equation – Similarity based on 2D fingerprints – Maximum Common Subgraph similarity –Cluster Analysis – Introduction to High-Throughput Screening Data

Reference Books :

1. Andrew R. Leach, Valerie J. Gillet, An introduction to chemoinformatics, Springer, 2005.
2. Johann Gasteiger, Thomas Engel, Chemoinformatics, Wiley-VCH, 2003
3. Handbook of Chemoinformatics, Johann Gasteiger, Wiley-VCH 2003.
4. B.A. Bunin, J. Bajorath, B. Siesel, G. Morales,Chemoinformatics: theory, practice and products, Springer, 2007
5. Richard G. Brereton, Chemometrics Data Analysis for the Laboratory and Chemical Plant, John Wiley & sons, 2003.
6. H. Holtje, W. Sippl, D. Rognan, G. Folker, Molecular modeling, Wiley-VCH, 2003.

15CH3026 ENVIRONMENTAL ELECTROCHEMISTRY

Credit: 3:0:0

Course objectives :

Student will learn on topics linking environmental issues such as

- Environmental phenomena,
- Environmental protection, remediation
- Manmade environmental damages, with electrochemical phenomena.

Course Outcome :

- The students will be exposed to basics in electrochemistry, and
- Electrochemically oriented environmental issues.

Course Description :

Principles of electrolyte solutions-reactions at the electrode-solution interface the electrical double layer, Gouy-Chapman-Stern theory for the structure of the electrical double layer-. electrochemical kinetics-Electron-transfer through the interface- Tafel equation - Electrokinetics-electroosmosis-Helmholtz-Smoluchowski equation-Electrochemical reactors- Environmentally-related electrochemical issues-Electrochemical methods for water and wastewater purification- fuel cells and bioelectrochemistry for cleaner energy, electrocoagulation.

Reference Books :

1. J. Koryta, j. Dvorak, L. Kavan “Principles of Electrochemistry”, John Wiley Publishers, 1993.
2. S. Glasstone, Textbook of Physical Chemistry, Macmillan, Bomby, India, 2nd edition, 1974.
3. 3.Duncan A MacInnes, “The principles of Electrochemistry”, Reinhold publishing corporation, 1998.
4. Bockris & Reddy, “Modern Electrochemistry”, Springer, Volumes 1 & 2, 1973.
5. K Scott, "Electrochemical Reaction Engineering”, Academic Press, London1991.
6. P. Delahay, Double Layer and Electrode Kinetics”, USA: Wiley-Interscience, 1965.
7. C. A. C. Sequeira ,"Environmental oriented electrochemistry", Elsevier 1994.
8. Christos Comninellis, Marc Doyle, Jack Winnick, "Energy and electrochemical processes for a cleaner environment: proceedings" by Electrochemical Society, International Society of Electrochemistry, Electrochemical society Etats-Unis Energy technology division, Electrochemical Society Meeting. - Science – 2001.

15CH3027 MOLECULAR MACHINES AND MATERIALS

Credits: 3:0:0

Course Objectives :

- The students will learn the advanced concepts and the molecular nanotechnology of the future viz., molecular machines and switches.
- Information on modern chemistry which aids the students get motivated and prepared to do research after their masters.
- Imparting knowledge on the conceptual foundations of the possible near future inventions of miniature molecular devices.

Course Outcomes :

- The students will understand the working principles of molecular machines and materials and the ways of assembling new molecular machines.
- They will learn the structure, function, and applications of molecular machines, switches, and devices.

Course Description :

Molecular machines – concept of a mechanical bond – threading followed by stoppering protocol and clipping protocol in the synthesis of rotoxanes – slippage and ring shrinkage – solvophobically driven templation – application – light driven molecular motors – molecular motors operating on surfaces – Molecular electronics – Molecular logic – types and functions – potential applications – rotors and motors on surfaces – the challenge of unidirectional molecular rotation – Molecular devices – molecular ammeter – molecular keypad lock

Reference Books :

1. Jean–Pierre Sauvage, Pierre Gaspard, From Non-covalent Assemblies to Molecular Machines, Wiley–VCH, 2011.
2. Ben Feringa, Molecular Switches, Wiley–VCH, 2001.
3. Manfred Schliwa, Molecular Motors, Wiley–VCH, 2003.

15CH3028 SELF ORGANIZATION AND SELF-ASSEMBLY IN NANOSTRUCTURES

Credits: 3:0:0

Course Objectives :

- The students will learn the structural chemistry of popular nanoconstructs of current importance.
- Information on modern chemistry which aids the students get motivated and prepared to do research after their masters.
- A knowledge on the scaling laws of nanochemistry.

Course Outcomes :

- The students will know the selectivity in formation of molecular and materials self-assembly and the factors governing it.
- They will learn the structure, function, and applications of nanochemistry in developing new ideas related to medicine and energy applications.

Course Description :

Core concepts of nanochemistry – Self organization vs. Self-assembly – pattern formation - surface, size, shape, defects, self-assembly, and bio-nano interface – five faces of nanochemistry: gold, polydimethylsiloxane, cadmium selenide, iron oxide, carbon – self-assembled monolayers – layer-by-layer self-assembly – self-assembly of nanoparticles, nanorods and tubes – bioinspiration in nanochemistry.

Reference Books :

1. Ludovico Cademartiri, Geoffrey A. Ozin, Concepts of Nanochemistry, 2009, Wiley-VCH
2. Geoffrey A. Ozin, A.C. Arsenault, Nanochemistry: A Chemical Approach to Nanometrials, RSC Publishing, 2005.
3. Zhong Gao, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, Imperial College Press, London, UK, 2004.
4. John. A. Pelesko, Self Assembly: The Science of Things That Put Themselves Together, Chapman & Hall/CRC, 2007.

LIST OF SUBJECTS

Subject Code	Name of the Subject	Credits
14CH1001	Applied Chemistry	3:0:0
14CH1002	Applied Chemistry Lab	0:0:2
14CH1003	Environmental studies	3:0:0
14CH2001	Basic Inorganic Chemistry	3:0:0
14CH2002	Transition metal and Coordination chemistry	3:0:0
14CH2003	Advanced Inorganic Chemistry	3:0:0
14CH2004	Qualitative analysis and inorganic preparations lab	0:0:2
14CH2005	Titrimetric Analysis And Gravimetric Analysis Lab	0:0:2
14CH2006	Basic Organic Chemistry	3:0:0
14CH2007	Aliphatic and Aromatic Chemistry	3:0:0
14CH2008	Basic Reaction Mechanism	3:0:0
14CH2009	Organic Qualitative Analysis Lab	0:0:2
14CH2010	Organic Preparations Lab	0:0:2
14CH2011	Thermodynamics and Kinetics	3:0:0
14CH2012	Electrochemistry, Catalysis and Colloidal Chemistry	3:0:0
14CH2013	Photochemistry, Nuclear Chemistry and Corrosion	3:0:0
14CH2014	Physical Chemistry Lab – I	0:0:2
14CH2015	Physical Chemistry Lab – II	0:0:2
14CH2016	Chemistry for Civil Engineers	3:0:0
14CH2017	Chemistry for Mechanical and Aerospace Engineers	3:0:0
14CH2018	Chemistry for Electrical and Electronics Engineers	3:0:0
14CH2019	Chemistry for Computer Engineers	3:0:0
14CH2020	Chemistry for Biologists	3:0:0
14CH2021	Chemistry for Food Science Engineers	3:0:0
14CH2022	Structural Chemistry for Biologists	3:0:0
14CH2023	Applied Nanochemistry and Next Generation Materials	3:0:0
14CH3001	Polymer Chemistry	3:0:0
14CH3002	Nanochemistry	3:0:0
14CH3003	Nanotechnology for Energy Applications	3:0:0
14CH3004	Analytical Chemistry	3:0:0
14CH3005	Chemical Approach to Nanomaterials	3:0:0
14CH3006	Medicinal Chemistry	3:0:0
14CH3007	Supramolecular Chemistry	3:0:0
14CH3008	Corrosion Science and Engineering	3:0:0
14CH3009	Nanotechnology for Medicinal Applications	3:0:0
14CH3010	Polymers for Nanotechnology	3:0:0
14CH3011	Technical Textiles	3:0:0
14CH3012	Metals in Biology	3:0:0

14CH1001 APPLIED CHEMISTRY

Credits: 3:0:0

Objective:

- To understand problems associated with hard water and treatment methods.
- To learn about fabrication of polymers, industrially important polymers and their bio-degradability.
- To know about calorific value of fuels, methods to improve anti-knocking characteristics, bio-fuels and flue gas analysis.
- To have understanding about construction and working of batteries, corrosion – types and control methods.
- To impart the basic aspects of inorganic engineering materials.

Outcome:

- To suggest methods to minimize problems related to hard water in industrial operations.
- To select and use eco-friendly fuels and biodegradable polymers for industrial and domestic purpose.
- To use appropriate methods to minimize corrosion of metals.

Course Description:

Water Technology – Sources of Water – Softening of hard Water – High polymers – Classification – Types – Industrial Polymers – Biodegradable Polymer – Fuels – Classification – Solid Fuels – Liquid Fuels – Gaseous Fuels – Biofuels – Electrochemistry – Nernst Equation – Electrochemical cells – Batteries – Corrosion –Engineering Materials – Refractories – Abrasives – Insulators – Lubricants

Reference Books:

1. Jain P. C, Monica Jain, "A text book of engineering chemistry", Dhanapat Rai publications, New Delhi, 12th edition, 2006.
2. Subha Ramesh, Vairam, Anandhan, "Engineering Chemistry", Wiley India Pvt. Ltd., New Delhi, 2011
3. Gowrikar V. R, Viswanathan N. V, Jaydev Sreedhar, "Polymer Science", New Age International Pvt. Ltd., New Delhi, 2000.
4. Agarwal C. V, "Chemistry of Engineering materials", C.V. Tara Book Agency, 1982.
5. Shashi Chawla, "A text book of engineering chemistry", Dhanapat Rai publications, New Delhi, 8th edition, 2008.

14CH1002 APPLIED CHEMISTRY LAB

Credits: 0:0:2

Objective:

- To train the students in gaining hands on experience to handle various applied chemistry laboratory techniques.

Outcome:

- The students can apply their theoretical applied chemistry knowledge in practical applications

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14CH1003 ENVIRONMENTAL STUDIES

Credits: 3:0:0

Objective:

- To acquire knowledge of elements of environment, it's need & importance.
- To know about pollution problems and green technology.
- To develop a sense of responsibility about the role of students in fostering the idea of learning to live in harmony with nature.
- To create an awareness about the major environmental issues for a sustainable development.

Outcome:

- At the end of this course the students are expected to understand the importance of environment, the effect of technology on the environment and ecological balance
- To make the students sensitive to the environment problems in every professional endeavor in which they participates.

Course Description:

Environment - Definition, Scope And Importance , Renewable And Non-Renewable Resources – Natural Resources– Ecosystem – Energy Flow - Biodiversity — Values -Hot-Spots – Various types of Pollution – Nuclear Hazards – Solid Waste Management -From Unsustainable To Sustainable Development – Urban Problems Related

To Energy – Water Conservation–Environmental Ethics — Environment Protection Acts–-Population Growth and Explosion—– HIV/AIDS –Role Of Information Technology– Disaster Management

Reference Books:

1. Deeksha Dave, "Environmental Studies", Cengage Learning India Pvt Ltd, New Delhi – 2011
2. Raman Shivakumar ,"Introduction Environmental science and Engineering" ,Tata Mc Graw Hill, 2010.
3. Bharucha Erach, "Text book on environmental studies" For Undergraduate Courses of all Branches of Higher Education, University Grants Commission, New Delhi, 2004.
4. Abnubha Kaushik, Kaushik C.P., "Perspectives in Environmental Studies" New Age International Publishers, Third Edition, 2009.
5. Sharma B.K. "Environmental Chemistry" Comprehensive covering the UGC Syllabus, 11th Edition, Goel Publishing House, Meerut, Eleventh Edition, 2007.

14CH2001 BASIC INORGANIC CHEMISTRY

Credits: 3:0:0

Objective:

- To explain the importance of atomic structure and chemical bonding.
- To get thorough knowledge about various kinds of bonding in inorganic chemistry
- To expose to theory of acids and bases.

Outcome:

- Students will have the knowledge of atomic structure
- The students will know the basis of various types of bonding .
- The students will have a complete understanding of acid base theory

Course Description:

Atomic structure – Dual Nature of electrons - Bohr theory – Shraodinger equation – Hund'srule - Types of Bonds – Ionic bond – radius ratio – Ionic compounds of type AX, AX2 – Born Lande equation – Defects – Metallic bond – Properties– Superconductivity – Born Haber cycle – Covalent bond - Lewis theory -VSEPR Theory-VB theory–σ and bonds. Molecular Orbital theory- LCAO method–diatomic molecules -Acids and Bases - Bronsted Lowry and Lewis theory – Acids and Bases - Hard and Soft acids and bases - Applications

Reference Books:

1. Lee J. D, "Concise Inorganic Chemistry", Wiley India (P.) Ltd, New Delhi, India, 5th edition, Reprint 2009.
2. Madan R. D, "Modern Inorganic Chemistry", S. Chand and Company Ltd, NewDelhi, India, 3rd edition, 2011.
3. Sharpe A.G. "Inorganic Chemistry", Dorling Kindersley (India) Pvt. Ltd, 2nd impression, 2008.
4. W. H. Madan, G. D. Tuli, R. D.Madan, "Selected Topics in Inorganic Chemistry", S. Chand & Company Ltd, Reprint 2009.
5. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.

14CH2002 TRANSITION METAL AND COORDINATION CHEMISTRY

Credits: 3:0:0

Objective:

- To explain the various theories of coordination chemistry
- To explain the nomenclature and isomerism in coordination compounds
- To get thorough knowledge about transition metal inorganic chemistry

Outcome:

- The students will know the properties of transition metal compounds
- Students will have the complete understanding of formation of coordination complexes
- The students will know the importance of crystal field theory

Course Description:

Transition metals –Properties –variable oxidation state color -magnetic properties- size - Difference between the first row & the other two rows – catalytic properties - Coordination compounds – Nomenclature - Werner's theory – effective atomic number - shapes of d orbital – Valence bond Theory – Crystal Field theory–Octahedral Complex- effect of crystal field splitting - John-Teller distortion – square planar and Tetrahedral complexes- – MO theory – chelates Isomerism

Reference Books:

1. Lee J. D, "Concise Inorganic Chemistry", Wiley India (P.) Ltd, New Delhi, India, 5th edition, Reprint 2009.
2. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
3. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
4. W. H. Madan, G. D. Tuli, R. D.Madan, "Selected Topics in Inorganic Chemistry", S. Chand & Company Ltd, Reprint 2009.
5. Sharpe A.G. "Inorganic Chemistry", Dorling Kindersley (India) Pvt. Ltd, 2nd impression, 2008.

14CH2003 ADVANCED INORGANIC CHEMISTRY

Credits: 3:0:0

Objective:

- To explain the importance and properties of F-block elements.
- To explain the fundamentals of organometallic and bioinorganic chemistry
- To expose to inorganic cpolymer chemistry

Outcome:

- Students will have the thorough knowledge of chemistry of f-block elements
- The students will know the importance oforganometallic chemistry and bioinorganic chemistry.
- The students will know the applications of important inorganic polymers

Course Description:

F block elements – separation - Electron structure —oxidation state - properties – color and spectra - lanthanide contraction - Uranium extraction – Nuclear fission - Organometallics - metal carbonyls - ferrocene – catalysis - Zeigler Natta catalyst – Bio inorganic chemistry of Iron, Cobalt, Copper and Zinc (Introductory concepts only) – Hemoglobin -Main group Chemistry - Allotropy of carbon- graphite and Diamond - Classification of Silicates – Cement - Ceramics- Glasses- Inorganic polymers – Silicones- phosphazenes – (SN)x.

Reference Books:

1. Lee J. D, "Concise Inorganic Chemistry", Wiley India (P.) Ltd, New Delhi, India, 5th edition, Reprint 2009.
2. Shriver and Atkins, " Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
3. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
4. W. H. Madan, G. D. Tuli, R. D.Madan, "Selected Topics in Inorganic Chemistry", S. Chand & Company Ltd, Reprint 2009.
5. Sharpe A.G. "Inorganic Chemistry", Dorling Kindersley (India) Pvt. Ltd, 2nd impression, 2008.

14CH2004 QUALITATIVE ANALYSIS AND INORGANIC PREPARATIONS LAB

Credits: 0:0:2

Objective:

- To provide the students an appreciation for the synthesis of Inorganic Complexes.
- To provide the students a competence in the laboratory skills required for accurate and precise chemical analysis.
- The students will know the theoretical basis of qualitative inorganic analysis containing common and less common ions.

Outcome:

- The student will gain the laboratory skills to synthesize the inorganic complexes
- will be confident in analyzing the mixtures containing common and less common ions using semimicro analysis
- Their separation skills will be improved

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14CH2005 TITRIMETRIC ANALYSIS AND GRAVIMETRIC ANALYSIS LAB

Credits: 0:0:2

Objective:

- To enrich the knowledge of estimation through titrimetric
- To gain some insights towards gravimetric skills
- To improve the Quantitative analytical skills

Outcome:

- Students acquire the knowledge of acidimetry and permanganometry,
- They understand the importance of iodometry, complexometry and dichrometry
- They can estimate any compound by gravimetry.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14CH2006 BASIC ORGANIC CHEMISTRY

Credits: 3:0:0

Objective:

- The student will get rudimentary ideas on chemical structure
- Versatile knowledge about the formula of organic Molecules.
- The student will have an idea about stereoisomerism and conformation in chemical structure and properties of molecules.

Outcome:

- The students will get the understanding on the structural basics of organic compounds
- They will understand the nomenclature of Organic compounds
- To Understand the stereoisomerism and conformation of organic molecules

Course Description:

Classification and Nomenclature of organic and heterocyclic compounds – Electrophiles and nucleophiles – Carbocation and Carbanion, Free radicals, Arynes - Inductive effect and field effect – Hyperconjugation –

Tautomerism - Substitution reactions, Addition reactions, Elimination reactions, Rearrangement reactions – Kinetic and thermodynamic control - Stereoisomerism – Cis-trans isomerism – E, Z nomenclature – Optical isomerism – Absolute configuration – R, S nomenclature – Cahn, Ingold, Prelog nomenclature - conformation and configuration – Conformation of ethane and cyclohexanes

Reference Books:

1. Bhupinder Mehta, Manju Mehta, Organic Chemistry, Prentice Hall of India private ltd., New Delhi, 2008.
2. Nasipuri, stereochemistry of organic compounds: principles and applications, New Academic Science Limited, 2012
3. O.D. Tyagi, M. Yadav, A Text Book of Organic Chemistry, Anmol Publishing Ltd., New Delhi, 2009
4. P.S. Kalsi, Stereo Chemistry Conformation and Mechanism, New Age Publishing Ltd., New Delhi, 6th Edition, 2005.
5. Jerry March, Advanced Organic Chemistry, Willey, 6th Edition, Newyork, 2007
6. I.L. Finar, Organic Chemistry, Pearson Education Pvt. Ltd., Vol. I & II, 6th Edition, Singapore, 2002
7. R.T. Morrison & R.N. Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt Ltd., Singapore, 2003

14CH2007 ALIPHATIC AND AROMATIC CHEMISTRY

Credits: 3:0:0

Objective:

- The student will be exposed to ideas about Aliphatic and aromatic compounds, their preparation and chemical properties.
- The student will learn about some common organic reactions
- To have an idea about the molecular rearrangements.

Outcome:

- The students will get knowledge on the reactions of carbonyl and nitrogen containing compounds
- They gain the knowledge about the molecular rearrangements
- They gain insights about features of commonly used name reactions

Course Description:

Aliphatic carbonyl compounds – Aliphatic nitrogen containing compounds – Aromatic aldehydes and ketones – Aromatic carboxylic acids – mono and dicarboxylic acids - Aromatic nitrogen containing compounds – Azines - Arenediazonium salts – Aldol, Perkin, Dieckman condensations – Reimer-Tiemann, Grignard reactions – Gattermann reaction, Friedel-Crafts reaction, Wittig reaction, Clemmensen reduction, Baeyer-Villiger reaction, Fries reaction, Stevens, Benzil-benzilic acid rearrangement, Curtius rearrangement, Hoffmann rearrangements

Reference Books:

1. Bhupinder Mehta, Manju Mehta, Organic Chemistry, Prentice Hall of India private ltd., New Delhi, 2008.
2. O.D. Tyagi, M. Yadav, A Text Book of Organic Chemistry, Anmol Publishing Ltd., New Delhi, 2009
3. Jerry March, Advanced Organic Chemistry, Willey, 6th Edition, Newyork, 2007
4. F. A. Carey & R. J. Sundberg. Advanced Organic Chemistry, Part A and B, 5th Edition. 2007.
5. Wamser & Harris, Fundamentals of Organic Reaction Mechanisms, John Wiley (1990).
6. R.T.Morrison & R.N.Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt Ltd., Singapore, 2003

14CH2008 BASIC REACTION MECHANISM

Credits: 3:0:0

Objective:

- Chemical reactions, which are mostly used to synthesize compounds of various types, and their mechanism, are discussed.
- Distinguishing the types of reactions and their mechanism will give an idea of the structural requirements of reactions of a particular type.

- The student will be able to write a reaction by explaining which bonds are broken and in what order.

Outcome:

- The students will get a thorough knowledge on the operating in the reactions of organic compounds and mechanism.
- Learn to identify the reaction mechanism
- Students can design new organic reactions based on the knowledge about reaction mechanism

Course Description:

The S_NAr mechanism – illustration with an example - benzyne mechanism – illustration with an example - S_N1 and S_N2 mechanisms – illustration with an example - neighboring group participation – Examples - Arenium ion mechanism – illustration with an example - Hammett equation – S_E2 mechanism – illustration with an example - S_E1 mechanism – illustration with an example - Addition reactions - illustration with an example - Elimination reactions – mechanism – illustration with an example - E_1, E_2 mechanisms - illustration with an example -

Reference Books:

1. Jerry March, Advanced Organic Chemistry, Willey, 6th Edition, Newyork, 2007
2. F. A. Carey & R. J. Sundberg. Advanced Organic Chemistry, Part A and B, 5th Edition. 2007.
3. S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan Publishers, India Limited, Reprinted, 2010
4. R.T.Morrison & R.N.Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt Ltd., Singapore, 2003
5. S. H. Pine, Organic Chemistry, 5th edn., McGraw-Hill, 1987
6. Wamser & Harris, Fundamentals of Organic Reaction Mechanisms, John Wiley (1990).

14CH2009 ORGANIC QUALITATIVE ANALYSIS LAB

Credits: 0:0:2

Objective:

- Enable to identify the functional group of the organic compound
- To obtain the practical skills in setting up of an organic reaction
- To prepare small organic molecules as derivatives

Outcome:

- Knowledge of systematic analysis of an organic compound
- The students will have the knowledge of identifying the functional groups of the organic compounds
- They will equip themselves in the preparation of simple organic compounds and understand their mechanism

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14CH2010 ORGANIC PREPARATIONS LAB

Credits: 0:0:2

Objective:

- Employ various reaction types to prepare organic compounds
- To train themselves in setting up of an organic reaction
- To have knowledge about handling the chemicals and laboratory scale preparations

Outcome:

- Understanding of the reaction conditions for various organic reactions
- They will equip themselves in the preparation of simple organic compounds
- They understand the mechanism of the reactions

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14CH2011 THERMODYNAMICS AND KINETICS

Credits: 3:0:0

Objective:

- To study the physical properties of solids
- To get thorough knowledge about the principles of chemical theromodynamics
- To study the chemical equilibrium and the chemical kinetics of reactions

Outcome:

- To know the physical characteristics of solids
- To understand the thermodynamic principles
- To understand the concepts of chemical equilibrium and chemical kinetics

Course Description:

The solid state – Crystal systems – Liquid crystals – Chemical thermodynamics – Thermodynamic processes – First law of thermodynamics – Thermochemistry – Second law of thermodynamics – Carnot's theorem – Maxwell's relations – Chemical Equilibrium – Spontaneous reactions – The van't Hof reaction – Heterogeneous equilibria – Chemical Kinetics – Overview of first, second, third and zero order reactions – Kinetics of fast reactions – Flow methods for fast reactions - Pulse methods – Flash photolysis – Pulse radiolysis .

Reference Books:

1. B.R. Puri, L.R. Sharma and Madan S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., Jalandhar, 2008
2. J. C. Kuriacose and J.Rajaram, "Thermodynamics for students of chemistry", 3rd Edition, Shoban Lal Nagin Chand & Co., Jalandhar, 1999 (recent edition)
3. Un Dash, Op Dharmarha and P.L. Soni, "Text book of Physical Chemistry", Sultan Chand & Sons, New Delhi, 2011
4. Samuel H. Maron and Carl F. Prutton, "Principles of Physical Chemistry", fourth edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1965 (reprinted in 2009)
5. K.J. Laidler, "Chemical Kinetics", 3rd Edition 1997, Benjamin-Cummings. Indian reprint – Pearson, 2009
6. C. Kalidas, "Chemical Kinetic Methods: Principles of Relaxations Techniques and application", New Age International (P) Ltd, Chennai,1996 (recent edition)
7. M.J. Piling and P.W. Seakins, "Reaction Kinetics", Oxford University Press, 2nd edition, 1996 (recent reprint)

14CH2012 ELECTROCHEMISTRY, CATALYSIS AND COLLOIDAL CHEMISTRY

Credits: 3:0:0

Objective:

- To study the fundamental concepts of electrochemistry
- To study the principles of quantum chemistry and surface chemistry
- To study colloidal chemistry and phase equilibria

Outcome:

- To get a basic knowledge about electrochemistry
- To understand the theory involved in quantum chemistry and surface chemistry
- To come to know about the colloidal solutions and phase equilibria of one and two component systems

Course Description:
Electrochemistry – Kohlrausch's law – Activity coefficients of electrolytes – The Nernst equation – Quantum Chemistry –The Compton effect – Scrondinger equation – Antisymmetry and Pauli's exclusion principle – Aufbau principle – Born Oppenheiner approximation – LCAO, MO and VB treatments of hydrogen molecule - Catalysis and surface chemistry – Enzyme catalysis – The Michaelis-Menten equation – Colloidal Chemistry – Emulsion – Osmosis – Phase rule - One component system – Two component system – Solid solutions.

Reference Books:

1. Samuel Glasstone, "An introduction to electrochemistry" Atlantic Publishers, 2007
2. B.R. Puri, L.R. Sharma and Madan S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., Jalandhar, 2008
3. A.K Chandra, "Introduction to Quantum Chemistry", Tata McGraw Hill, New Delhi, 1997 (recent edition)
4. A.W. Adamson, "Physical Chemistry of Surfaces", 5th edition, Wiley, 1997 (recent edition)
5. Un Dash, Op Dharmarha and P.L. Soni, "Text book of Physical Chemistry", Sultan Chand & Sons, New Delhi, 2011
6. Peter Atkins, "Elements of Physical Chemistry", OUP Oxford, 6th edition, 2012
7. I.N. Levine, "Quantum Chemistry", Pearson Education Inc., 2003 (recent edition)

14CH2013 PHOTOCHEMISTRY, NUCLEAR CHEMISTRY AND CORROSION

Credits: 3:0:0

Objective:
- To study the fundamental concepts of photochemistry
- To study the principles of radiochemical reactions
- To study the applied concepts of electrochemistry

Outcome:
- To get a basic knowledge about photochemical reactions
- To understand the concepts of radiochemistry and its applications
- To understand the advanced applications of electrochemistry

Course Description:
Photochemistry – Laws – Quantum yield – Photosensitized reactions – Photophysical processes – Fluorescence – Phosphorescence – Chemiluminescence – Nuclear Chemistry – Radioactivity – Detection and measurement of radioactivity – Half life - Nnuclear reactions – Nuclear Reactor – Hydrogen bomb - Advanced Electrochemistry – Battery technology – Battery characteristics – Classical batteries – Modern batteries – Lithium cells/ Batteries - Corrosion of metals – Types of corrosion – Factors affecting corrosion – Passivation of metals - Metal finishing – Types of metal finishing.

Reference Books:

1. K.K. Rohatgi-Mukherjee, "Fundamentals of Photochemistry", New Age International (P) Ltd., 2006
2. Angelo Albini, "Photochemistry – Vol. 38", Royal Society of Chemistry, 2011
3. Giridhar Sharma, "Advanced Electrochemistry", Campus Books International, 2010
4. Thomas Reddy, "Linden's Hand Book of Batteries", McGraw Hill Professional, 2010
5. E. McCafferty, "Introduction to Corrosion Science, Springer, 2010
6. Milan Paunovic, "Modern Electroplating ", 5th Edition, Wiley, 2010
7. M. Sharon, "Nuclear Chemistry", Ane Books Pvt. Ltd., 2009

14CH2014 PHYSICAL CHEMISTRY LAB – I

Credits: 0:0:2

Objective:

- To train the students on instrumental methods of analysis
- To carryout experiments on chemical kinetics
- To get an basic idea about electrochemistry

Outcome:

- Understand the principle and working of various instrument methods of analysis.
- To apply the principle of chemical kinetics
- To apply the knowledge in measuring real samples

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14CH2015 PHYSICAL CHEMISTRY LAB – II

Credits: 0:0:2

Objective:

- To do experiments based on phase rule and absorption.
- To do experiments based spectrophotometry
- To gain some idea in distribution coefficient and equilibrium constant

Outcome:

- To apply principles of absorption, phase rule, distribution coefficient and equilibrium constant
- To understand applications of spectrophotometry
- To apply the knowledge in measuring real samples

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14CH2016 CHEMISTRY FOR CIVIL ENGINEERS

Credits: 3:0:0

Objective:

- To understand the application of composites as building materials
- To familiarize the student with various types of testing and treatment of water and sewage
- To impart the basic knowledge of chemical composition of building materials
- To learn the application of organic binders and paints

Outcome:

- Students will have the knowledge of chemistry concepts of building materials, organic binders and road marking paints
- Students will have complete understanding of the testing and treatment methods of water and sewage

Course Description:

Water quality analysis – pH, Total dissolved solids, Total suspended solids, Hardness, Determination of Na, K, Fe, Sulphate, chloride, fluoride, phosphate, silica content, BOD, COD- Sewage – constituents of sewage – aerobic and anerobic oxidation – primary, secondary and tertiary treatment – cement – classification- manufacturing process- decay of cement- Portland cement – plaster of paris-porcelain – properties and applications- Composites – constituents – types – application – fibre reinforced composites and its types –nanocomposites – organic coatings – paints – formulation of paints-failure-varnishes-lacquersc - special paints –adhesives – adhesive action – factors influencing adhesive strength

Reference Books:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Co. (P) Ltd., New Delhi, 2010.
2. Shashi Chawla, "Text book of Engineering Chemistry", Dhanpat Rai & Co. (Pvt.), Ltd., New Delhi, 2008.
3. N.Manivasakam, "Physico-chemical examination of water sewage and industrial effluents" Pragati Prakashan, 1996
4. S.S. Dara, A text book of engineering Chemistry I and II, 4th revised edition, S. Chand and co, 1994.

14CH2017 CHEMISTRY FOR MECHANICAL AND AEROSPACE ENGINEERS

Credits: 3:0:0

Objective:

- To explain the fundamentals of Protective coatings and surface chemistry
- To get thorough knowledge about Composite materials and Alloys

Outcome:

- The students will know the phase rule and composition behind the various metal alloys
- Students will have the complete understanding of fabrication of polymer composites

Course Description:

Phase rule – Two component alloy system - Surface Chemistry – Adsorption - Classification – Application – Langmuir adsorption Equation – Polymers – Structure-properties correlations – Important organic and inorganic polymers – Fabrication of Polymer Composites- Composites – Constituents – Types – FRC – Metallurgy –Steps – Alloys –Heat treatment of steel - Electroplating – Characterization – Methods - Paint

Reference Books:

1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) Ltd, New Delhi, India, 15th Edition, 2009
2. Gowrikar V. R, Viswanathan N. V, Jaydev Sreedhar, "Polymer Science", New Age International Pvt. Ltd., New Delhi, 2000.
3. Subha Ramesh, Vairam, Anandhan, "Engineering Chemistry", Wiley India Pvt. Ltd., New Delhi, 2011.
4. Agarwal C. V, "Chemistry of Engineering materials", C.V. Tara Book Agency, 1982.
5. Palanna O. G, "Engineering Chemistry", Tata McGraw Hill Education pvt., Ltd., New Delhi, 2009.

14CH2018 CHEMISTRY FOR ELECTRICAL AND ELECTRONICS ENGINEERS

Credits: 3:0:0

Objective:

- To know the significance of electromagnetic radiation and its interaction
- To understand the basic concepts about the photochemistry
- To know the importance of semiconductors and device fabrication
- To study the superconducting materials, lithography and energy storage devices
- To know about new generation materials used in LEDs and in other applications

Outcome:

- Students will have the wide spectrum of knowledge in electromagnetic radiation, photochemical reaction and its applications.
- The students will understand basic concepts of semiconductor, superconductors and LEDs.

Course Description:
Electromagnetic radiation – Absorption spectrophotometer instrumentations – Introduction to low energy radio waves – Laws of Photochemistry – Quantum efficiency – Photosensitization – Luminescence – LASER – Solar energy conversion – Semiconductors – Types – Devices – Superconductors – Fullerenes – Lithography – Graphene based energy storage devices – Signal transduction – Light emitting diode materials and devices – Polymers with piezoelectric, pyroelectric properties – Nano-materials – Catalysis, photovoltaic and medicine.

Reference Books:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Co. (P) Ltd., New Delhi, 2010.
2. G. Cao "Nanostructures and Nanomaterials", Imperial College Press, London, 2008.
3. P.R. Puri, L. R. Sharma and Madan S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., Delhi, 2008.
4. R.J. Young and P.A. Lovell, "Introduction to polymers", Rebika Press Pvt. Ltd., New Delhi, 2004.
5. K. Kalantar-zadeh and B. Fry, "Nanotechnology – Enabled Sensors", Springer, New York, 2010.

14CH2019 CHEMISTRY FOR COMPUTER ENGINEERS

Credits: 3:0:0

Objective:
- To know about fundamentals of materials chemistry and various classes of materials
- To study the characterization of materials by analytical techniques
- To know about photolithography and its applications

Outcome:
- The students will know the basics of materials chemistry
- The students will understand the application of materials in diversified fields

Course Description:
Fundamentals of materials chemistry – various classes of materials – solids – metals – semiconductors – super conductors – alloys – composite materials – characterization of materials – Instrumentation – X-ray Diffraction, UV-visible, microwave, IR and Raman spectrophotometer – Introduction to optical fiber and organic light emitting diode materials - Photolithography – Polymers with piezoelectric, pyroelectric and ferroelectric properties – Inorganic light emitting materials and devices – Synthesis, properties and their applications – Inorganic based nanomaterials and their potential applications in areas such as catalysis, photovoltaics and medicine.

Reference Books:

1. Harry R. Allcok, "Introduction to Materials Chemistry", John Wiley & Sons, New Jersey, 2008
2. Shashi Chawla, "A Text Book of Engineering Chemistry", Dhanpat Rai & Co., Delhi, 2008
3. Jain P.C. and Monica Jai, "Engineering Chemistry", Dhanpat Rai Publishing Co. (P) Ltd., New Delhi, 2010
4. Garry S. May and Simon M. Sze, "Fundamentals of Semiconductor Fabrication", John Wiley & Sons, Inc., 2004
5. William D Callister, Jr., "Materials Science and Engineering- An Introduction" Sixth Edition, John Wiley & Sons, New York, 2003

14CH2020 CHEMISTRY FOR BIOLOGISTS

Credits: 3:0:0

Objective:
- To have a thorough knowledge in preparing solutions for analytical testing
- To get an idea about the applications of the chromatography and microscopy
- To enable the students to understand the concepts in physical and chemical processes in living systems
- To provide an introduction to the basic analytical tools needed for experiments in Biology.

Outcome:

- The students will have the fundamental ideas on preparation of solution which are essential for wet analytical science
- They will understand the applications of microscopy and chromatography
- They gain some rudimentary ideas on solutions, colloids, and surfaces which are essential for wet analytical science

Course Description:

Mole concept. Principle of volumetric analysis acidity, alkalinity and buffer solutions - Free energy, enthalpy and entropy. Energetics of Metabolism and ATP cycle – Chemical potential – Gibbs Duhem equation – Statements and applications of distribution laws (without derivation) – Physical significance - Adsorption- Langmuir and Freundlich isotherms. BET equation (no derivation) and its application to surface area measurement. Sols (reversible and irreversible), Emulsions and Emulsifiers, Association colloids (micelles), Gels - Applications of colloids - Paper, thin-layer, gel-filtration, ion-exchange, affinity and High-Performance Liquid Chromatography (HPLC). Principles of Light, confocal, fluorescence and electron microscopy

Reference Books:

1. R. Gopalan, S. Sundaram, Allied Chemistry, Sultan Chand and Sons (1995).
2. Nelson, D.L. and Cox, M.M. (2005); Lehninger, Principles of Biochemistry, fourth edition, W.H.Freeman and company, N.Y. USA.
3. B. R. Puri, L. R. Sharma, and M. S. Pathania, Principles of Physical Chemistry, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
4. M. J. Sienko and R.A. Plane, Chemistry - Principles and properties, International Student Edition, 1995.
5. Voet, D and Voet, J.G, (2009) Biochemistry, John Wiley and Sons, N.Y. USA.
6. Bozollo JJ, Russell LD, Electron Microscopy, Edition II, Jones and Bartlett Publishers, Inc., Printed in India.

14CH2021 CHEMISTRY FOR FOOD SCIENCE ENGINEERS

Credits: 3:0:0

Objective:

- To get an understanding about the chemistry involved in Foods and Dyes
- To have a thorough knowledge in preparing solutions for analytical testing of Food
- To get an idea about the applications of the chromatography and microscopy

Outcome:

- Students will understand the chemistry involved in modern foods and drinks
- They will have a knowledge about the pigments and dyes used in day today life
- Student will have an introduction to the basic analytical tools needed for experiments in Biology.

Course Description:

Mole concept - Principle of volumetric analysis acidity, alkalinity and buffer solutions – Mushroom cultivation – fast foods - Production of bread, bun and biscuits – soft drinks – alcoholic beverages – Nitrogen Preservation and packing of fruit juices – Coconut water – Natural pigments – Carotenoids - Anthocyanin – Chlorophyll – synthetic dyes, types and detection - Paper, thin-layer, gel-filtration, ion-exchange, affinity and High-Performance Liquid Chromatography (HPLC). Principles of Light, confocal, fluorescence and electron microscopy

Reference Books:

1. R. Gopalan, S. Sundaram, Allied Chemistry, Sultan Chand and Sons (1995).
2. Nelson, D.L. and Cox, M.M. (2005); Lehninger, Principles of Biochemistry, fourth edition, W.H.Freeman and company, N.Y. USA.
3. Swaminathan M. Text Book on Food chemistry, Printing and Publishing Co., Ltd., Bangalore. 1993.
4. Mudambi. R. Sumathi, and Rajagopal, Fundamentals of Foods and Nutrition, M.V., Wiley Eastern Ltd., Madras.

5. M. J. Sienko and R.A. Plane, Chemistry - Principles and properties, International Student Edition, 1995.
6. Seema Yadav. Food Chemistry, Anmol publishing (P) Ltd, New Delhi
7. Voet, D and Voet, J.G, (2009) Biochemistry, John Wiley and Sons, N.Y. USA.

14CH2022 STRUCTURAL CHEMISTRY FOR BIOLOGISTS

Credits: 3:0:0

Objective:

- This course will cater to the students learning Biology–related subjects as their main course, in providing them knowledge of the chemical structures of biomolecules and molecules involved in biochemical pathways.

Outcome:

- The student will be able to systematically name organic and biomolecules, identify them, and understand the importance of these molecules in biological pathways.
- They can understand the structural requirement of molecules and drugs in achieving physiological functions and pharmacological actions.
- Molecular mechanisms taught in biology will be better understood, through a chemistry approach with a newer vista.

Course Description:

Atom models – Hybridization of orbitals – Types of bonds – van der Waals' force and Hydrogen bonding –VSEPR theory – Electronegativity, electron affinity, dipole moment – electronic and steric effects – Nomenclature of organic compounds. Stereoisomerism. Carbohydrates: classification, structure – ring structure of glucose. Structure of vitamins A, B, B_2, B_6, C, D, E, and K. Amino acids: classification with examples – Proteins: classification and structure. Enzymes: Fischer's and Koshland's theories – Michaelis–Menton plot. Structure of DNA – types of RNA – tertiary structure. Drugs: lead compound, prodrugs and soft drugs, pharmacophores – drug receptors – absorption, distribution, metabolism, and elimination – drug resistance – antibiotics, antipyretics, analgesics, hypnotics, and anti-neoplastics.

Reference Books:

1. O. D. Tyagi, M. Yadav, A Text Book of Organic Chemistry, Anmol Publishing Ltd., New Delhi, 2009.
2. Gurdeep R. Chatwal & M. Arora, Organic Chemistry of Natural Products, Vol. I & II, Himalaya Publishing House, 4th Edition, New Delhi, 1999.
3. Ashutosh Kar, Medicinal Chemistry, New Age International Publishers, New Delhi, 2007.
4. I. L. Finar, Organic Chemistry, Pearson Education Pvt. Ltd., Vol. I & II, 6th Edition, Singapore, 2002.
5. R. T. Morrison & R. N. Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt. Ltd., Singapore, 2003.

14CH2023 APPLIED NANOCHEMISTRY AND NEXT GENERATION MATERIALS

Credits: 3:0:0

Objective:

- The course will cover several key aspects of applied nanomaterials namely their synthesis, characterization, processing, and applications

Outcome:

- The students will know the various types of nanomaterials
- Students will have the complete understanding of properties and applications of nanomaterials

Course Description:

Introduction – Nanomaterials – Fabrication – Top-down, Bottom-up methods of generation – Metallic and Semiconductor Nanoparticles - Nanorod – Nanowire – Nanotube – Thin film — Epitaxy – Special nanomaterials –

Carbon nanotubes – Fullerenes – Inorganic nanocomposites – AFM – STM – TEM – Physical methods – Photolithography – Soft lithography – Properties – Optical – Electrical – Magnetic – Applications of Nanomaterials.

Reference Books:

1. G.Cao, "Nanostructures and Nanomaterials-Synthesis, Properties and Applications", Imperial College Press, London, 2008
2. M.A.Shah and T. Ahnmed, "Principles of Nanoscience and Nanotechnology", Narosa Publishing House, New Delhi, 2010.
3. Atkins, Overton, Rourke, Weller, Armstrong, " Shriver & Atkins Inorganic Chemistry", 4th Edition, Oxford University Press, New Delhi, 2010
4. Daniel L. Schodek, Paulo Ferreira, Michael F. Ashby, "Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers and Architects" Butterworth-Heinemann Ltd, UK, 2009

14CH3001 POLYMER CHEMISTRY

Credits: 3:0:0

Objective:

- To acquire knowledge about the basic principles of polymers
- To understand the moulding processes of polymers
- To understand the applications of polymers

Outcome:

- To get a basic knowledge about polymers
- To know their properties and various fabrication techniques
- To comprehend polymer nanocomposites and their applications

Course Description:

Basic concepts of polymers – Polymerization reactions – Polymer solutions – Principles and mechanisms of polymerization – Co-polymeization – Polymer properties -Molecular weight determination - Tg, Tm and their relationships – Elastic effect of polymers -Polymerization processes and fabrication of plastics - Moulding processes – Injection, compression, blow moulding, extrusion moulding, thermoforming - Introduction to conducting polymers and composites - Filler-matrix interaction - Surface treatment on nano-fillers – Applications of polymer nano-composites.

Reference Books:

1. V.R. Gowariker, N.V. Viswanathan, N.V.Jayadev Sreedhar, "Polymer Science", I edition, New Age International Publishers Pvt. Ltd., New Delhi, 2008.
2. G.S. Misra, "Introductory Polymer chemistry", New Age International Pvt. Ltd., 2008
3. Anil Kumar and Rakesh K. Gupta, "Fundamentals of polymer engineering" Tata McGraw Hill Publication Ltd., New Delhi, 2003 (revised and expanded edition)
4. R.J. Young, P.A. Lovell, "Introduction to polymers" Stanley Thomas Publishers, London, 2000
5. P. Bahadur, "Principles of polymer science", Alpha Science International Ltd., 2nd Edition, 2005.
6. G. Odian, "Principles of Polymerisation", IV Edition, Wiley Student Edition, New Delhi, 2007.
7. M.G. Arora, M. Singh and M.S. Yadav, "Polymer Chemistry" II revised Edition, Anmol Publications Pvt. Ltd., 2003

14CH3002 NANOCHEMISTRY

Credits: 3:0:0

Objective:

- To acquire the basic knowledge about nanochemistry
- To study the synthetic techniques of nanomaterials
- To study the applications of nanomaterials

Outcome:

- To know the processes involved in zero-dimensional, one-dimensional and two-dimensional nanomaterials
- To understand the methodologies to synthesize special nanomaterials
- To understand the characterization techniques

Course Description:

Basic concepts of nanochemistry – Self assembly of materials – Zero-Dimensional Nanostructures: Nanoparticles – Synthesis of semiconductor nanoparticles – Synthesis of oxide nanoparticles – One-Dimensional Nanostructures: Nanowires – Types – Electrospinning – Lithography - Two-Dimensional Nanostructures: Thin films – Physical vapour deposition (PVD) – Evaporation, molecular beam epitaxy (MBE) – Chemical vapor deposition (CVD) – Atomic layer Deposition (ALD) - Special Nanomaterials - Carbon Fullerens and carbon nanotubes - Nanocomposites and nanograined materials.

Reference Books:

1. Guozhang Gao, "Nanostructured & Nanomaterials – Synthesis, Properties and & Applications", Imperial College Press, London, 2004
2. C. Brechignac, P. Houdy and M. Lahmani, "Nanomaterials and Nanochemistry, Springer, 2008
3. Kenneth J. Klabunde, Gleb B. Sergeev, "Nanochemistry", Elsevier, NY, 2006
4. C.N.R. Rao, "The Chemistry of Nanomaterial: Synthesis, properties and applications, Volume I and II, Springer, 2006
5. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press, 2005
6. Patrick Solomon, "A Handbook on Nanochemistry", Dominant Publishers and Distributors, New Delhi, 2008
7. A.K. Haghi and M.R. Saboktakin, "Modern Nanochemistry: Synthesis, properties and applications, Vol. 2", Nov Science Publishers Inc., 2013

14CH3003 NANOTECHNOLOGY FOR ENERGY APPLICATIONS

Credits: 3:0:0

Objective:

- To acquire the basic knowledge about energy sources
- To study the electrochemical devices
- To study the principles of fuel cells and nuclear energy devices

Outcome:

- To know the chemistry and application of nanotechnology for energy sources
- To specifically understand the role of nanomaterials in solar cells, electrochemical devices, hydrogen storage and nuclear power devices
- To understand the applications of energy devices

Course Description:

Introduction to Energy Sources - Basic principle and operation of renewable energy resources - Nanotechnology for solar power - Nanotechnology for electrochemical devices - Lithium-ion batteries – Fuel cells – Characterization and evaluation of nanomaterials for proton exchange membrane fuel cells (PEMFC), Biofuel cells (BFC) solid oxide fuel cells (SOFC) - Nanotechnology for hydrogen storage materials - Development of hydrides for nanomaterials - Nanotechnology for Nuclear Power - Ni-Cr-Mo alloys for nuclear engineering – Nanocatalysis-Radiation protection materials – nanostructured Boron steels.

Reference Books:

1. Vaughn Nelson, "Introduction to Renewable Energy", CRC Press, 2011
2. Atul Tiwari, Rabah Boukherroub and Maheshwar Sharon, "Solar Cell Nanotechnology", Wiley, 2013
3. Yaser Abu-Lebeh and Isobel Davidson, "Nanotechnology for Lithium-ion batteries", Springer, 2012
4. Nitaigour Premchand Mahalik, "Micromanufacturing and Nanotechnology", Springer, 2006

5. Robert A Varin, Tomasz Czujko, Zbigniew S. Wronski, "Nanomaterials for solid state hydrogen storage", Springer, 2009
6. Ann Maczulak, "Renewable Energy : Sources and methods", Infobase publishing, 2010
7. John P. Reece, "New Nanotechnology Research", Technology & Engineering, 2006

14CH3004 ANALYTICAL CHEMISTRY

Credits: 3:0:0

Objective:

- To explain the importance of various analytical techniques used in chemistry
- To understand the principles of various analytical techniques
- To understand the applications of various analytical techniques

Outcome:

- Students will know the principles of various types of chromatographic separation techniques.
- The students will know the importance of electromagnetic spectrum.
- The students will apply the various spectroscopic techniques for structure elucidation of small molecules

Course Description:

Chromatography – Principles and applications of paper chromatography –thin layer chromatography -Liquid column, Solid/liquid, Liquid/liquid, Ion exchange and Gas chromatography- Electromagnetic spectrum – Infra red spectroscopy –Theory – Finger print region – Electronic spectroscopy – Principles –Woodword-Fieser rules – applications – 1H NMR spectroscopy –Theory – FT NMR - Chemical shifts in NMR – Reference compounds –- Solvents for NMR - Coupling constant in NMR - AX, AMX and ABX systems - Applications

Reference Books:

1. Chatwal G. R & Anand S. K, "Instrumental Methods of Chemical Analysis", Himalaya Publishing House, Mumbai, India, 5th Edition, Reprint 2011.
2. Kalsi P. S, "Spectroscopy of Organic Compounds", New Age International Publishers, New Delhi, 6th Edition, 2004.
3. Skoog D. A, West D. M, Holler F. J & Crouch S. R, "Fundamentals of Analytical Chemistry", Cengage Learning India Pvt. Ltd, New Delhi, India, 8th Edition, 2004.
4. Srivatsava A. K. & Jain P. C, "Chemical Analysis", S. Chand Publications, New Delhi, 3rd edition, 1997.
5. Willard H, Merrit L, Dean J. A. & Settle F.A., "Instrumental methods of chemical analysis", CBS Publishers and Distributors Pvt. Ltd, New Delhi, 7th edition, 1986.
6. Valcarcel, Miguel , Principles of Analytical Chemistry, Springer, 2000.
7. G. Sharma, B K Chaturvedi,Richard E. Wolfe, Basic Analytical Chemistry, DK publishers, 2011

14CH3005 CHEMICAL APPROACH TO NANOMATERIALS

Credits: 3:0:0

Objective:

- Soft lithographic patterning on the basis of chemistry will be discussed.
- The theory of materials preparation with soft building blocks and large building blocks will be taught to the students.
- The question of how chemistry uses bioinspiration for material preparation will be addressed.

Outcome:

- The student will get a thorough knowledge of molecular and material self assembly
- The students will know the importance of soft lithography
- The students will know the importance of bioinspired materials

Course Description:
Molecular vs Materials self assembly — Self Assembled Monolayer- Soft Lithography – PDMS stamp – Sub 100 nm Soft lithography –Dip Pen Nanoloithography – soft patterning of hard magnets – Enzyme DPN - Nanocluster self assembly- nanocrystal, nanoparticle, and nanocluster- Water soluble nanoclusters - Biominerals –-bioinspired materials – viral cage synthesis of nanoclusters – Polynucleotide directed nanocluster assembly –-Self-assembling nanorods – Nanorod devices – Nanowire sensors – illustration with examples.

Reference Books:

1. G. A. Ozin and A. C. Arsenault, "Nanochemistry: A chemical Approach to nanomaterials" RSC Publishing, 2005
2. Zhong Cao G, "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", Imperial College Press, London, United Kingdom, 2004.
3. Nanochemistry, G.B. Sergeyev, Elsevier, 2007.
4. Core Concepts on supramolecular chemistry and nanochemistry, Jonathan Steed, Wiley Eastern Publishers, 2006
5. Nano: The essentials, T. Pradeep, McGraw Hill Publishers, 2007.
6. Supramolecular chemistry –Fundamentals and applications advanced textbook, Katsuhiko Ariga · Toyoki Kunitake, Springer-Verlag, 2000.
7. D. Vollatah,, Nanomaterials: An Introduction to Synthesis, Properties and Applications, springer, 2011.

14CH3006 MEDICINAL CHEMISTRY

Credits: 3:0:0

Objective:

- To equip the students with a thorough understanding of different aspects of pharmaceutical chemistry
- To make them understand about the enzyme kinetics
- To gain some insights about the drug design

Outcome:

- After finishing this course, the student will be able to understand and apply the design and synthetic approaches used in pharmaceutical chemistry
- They will have the knowledge of enzyme kinetics
- They will be trained to design some small organic drug molecules

Course Description:
Introduction to drug design - Physical and chemical factors associated with biological activities - Classification of drugs based on structure or pharmacological basis with examples – Pro drugs and soft drugs – Enzymes and enzyme inhibitors – Ligand-receptor theories – Proteins, lipids, and nucleic acids as drug targets – Effect of pH, pKa, and polarity on drug solubility – Ideal requirement of a drug – sources of drug plant and animal origin, synthetic and semisynthetic drug – Mechanism of Drug Action - Therapeutic index and therapeutic ratio - Five classic steps in the design of a new drug – Factors affecting drug development.

Reference Books:

1. Ashutosh Kar, "Medicinal Chemistry" New Age International Publishers, 5th Revised and Expanded edition, 2010.
2. Richard B. Silverman, "The Organic Chemistry of Drug Design and Drug Action", 2nd Edition, Academic Press, Reprinted, 2010.
3. Rama Rao Nandella, "Principles of Organic Medicinal Chemistry" New AgeInternational Publishers, New Delhi, Reprint, 2008.
4. Gareth Thomas "Fundamentals of Medicinal Chemistry", London, Reprint, 2003.
5. David A. Williams, William O. Foye, Thomas L. Lemke, Lippincott Williams & Wilkins, Foye's Principles of Medicinal Chemistry, Philadelphia, 5th edition, 2002.
6. Donald J. Abraham, David P. Rotella, "Burger's Medicinal Chemistry, Drug Discovery and Development, 8 Volume Set, John Wiley & Sons Ltd., 7th Edition, 2003.

7. Graham L. Patrick, "An introduction to Medicinal Chemistry", Oxford university Press, 1995.

14CH3007 SUPRAMOLECULAR CHEMISTRY

Credits: 3:0:0

Objective:

- As the students have known the structural and functional basics of building blocks of supramolecular structures, he/she will now be taught how to build up such structures.
- A knowledge on the driving forces of supramolecular structure formation will be given to the student.
- The student will be exposed to ideas on the types of supramolecules based on structure and the chemistry behind host-guest assembly..

Outcome:

- The students will know the selectivity in supramolecule formation and various factors affecting it
- The students will know the complete understanding of solution host-guest chemistry
- The students will know the various types of supramolecular architectures

Course Description:

Definition – Supramolecular interactions -Selectivity — Lock and key principle – induced fit model – cooperativity – chelate effect – Preorganisation – Binding constant –Kinetic and thermodynamic selectivity - Solution host-guest chemistry – Macrocyclic vs acyclic host — Cation binding – Anion Binding -Neutral molecule binding – Self assembly – Definition – Biological self assembly – Ladders – Polygons –helices – Rotoxanes – Catenanes – Knots – Solid state supramolecules – Zeolites – Clathrates – Coordination polymers – Applications

Reference Books:

1. Jonathan Steed, David Turner, Carl Wallace, Core concepts in Supramolecular Chemistry and nanochemistry, John Wiley & sons, 2007.
2. Jean-Marie Lehn, Supramolecular Chemistry, RCS pubs., 2005
3. Supramolecular chemistry –Fundamentals and applications advanced textbook, Katsuhiko Ariga · Toyoki Kunitake, Springer-Verlag, 2000.
4. Nano: The essentials, T. Pradeep, McGraw Hill Publishers, 2007.
5. Nanochemistry, G.B. Sergeyev, Elsevier, 2007.
6. G. A. Ozin and A. C. Arsenault, "Nanochemistry: A chemical Approach to nanomaterials" RSC Publishing, 2005
7. Zhong Cao G, "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", Imperial College Press, London, United Kingdom, 2004.

14CH3008 CORROSION SCIENCE AND ENGINEERING

Credits: 3:0:0

Objective:

- To improve both the fundamental knowledge of the students about the corrosion of Materials.
- To introduce various types of corrosion
- The knowledge of the contemporary concepts for corrosion processes of metallic materials will be thought.

Outcome:

- Students will know the various types of corrosion
- The students will know the thermodynamics and kinetics of corrosion
- To know the corrosion prevention methods

Course Description:
The technology & evaluation of corrosion - Electrochemical mechanisms of corrosion of metals - Concentration polarization and diffusion –- Thermodynamics of corrosion – Corrosion kinetics – Types of corrosion - Corrosion cells - Partial corrosion reactions - Corrosion of materials in natural environments - Localized corrosion damages and materials failure - Methods for protection of materials - Corrosion control and monitoring – Corrosion inhibitors – Corrosion under organic coatings - AC impedance – High temperature oxidation

Reference Books:

1. M. G. Fontana "Corrosion engineering", Mc Graw Hill, New York, 1997
2. L L. Shreir, R. A. Jerman, G. T. Corrosion Metal Environment Reactions" eds. Burstein, Butterwirths, London, 1994
3. D. Gabe "Principles of Metal Surface Treatment and Protection", Merlin Books, London, 1993
4. Denny A. Jones, Principles and Prevention of Corrosion, 2nd Ed., Prentice-Hall, Inc., 1996
5. E. McCafferty, Introduction to Corrosion Science, Springer, 2010
6. R. Winston Revie, Herbert H. Uhlig, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, Fourth Edition, John Wiley & Sons, Inc.2008
7. McCafferty, Edward, Introduction to Corrosion Science, Springer, 2010.

14CH3009 NANOTECHNOLOGY FOR MEDICINAL APPLICATIONS

Credits: 3:0:0

Objective:

- To provide an introduction and involvement of Nano-scale formulated molecules/materials in the Medicinal Applications
- To provide the basic knowledge of nano-sized molecules in diagnostic applications.
- To explain the importance of nano-fabrication for therapeutic application, in addition to theragnostics applications

Outcome:

- Students will have the knowledge of nano-sized designs for various medicinal applications
- Loading and delivery of nano drugs through liposomal drug delivery
- Students will know the techniques of internalization with the help of vector and receptor strategy.

Course Description:
Nano formulations and measurement of size based system - liposomal, polysomal approach – nano sized drugs for Diagnostics, Therapeutic – *In-vivo* - Clinical Applications – Nano abrications for Theragnostics Applications. Potential nano scale materials and molecules for internalization and its techniques – Activation technology through Nano molecules and its potential applications – Receptor and Vector approaches with nano molecues, Drug Targeting approaches with nano molecules - Cellular Labeling approaches with nano molecules

Reference Books:

1. Arun Kumar, Heidi M. Mansour, Adam Friedman, Eric R. Blough, Nano Medicine in Drug Delivery, CRC Press, 2013.
2. Ajay Kumar Mishra, Nanomedicine for Drug Delivery and Therapeutics, Wiley Publishers, 2013.
3. Challa S. S. R. Kumar, Biomimetic and Bioinspired Nanomaterials, Wiley Publishers, 2010.
4. Harry F. Tibbals, Medical Nanotechnology and Nanomedicine, 2010,
5. Robert A. Freitas Jr. *Nanomedicine*, Volume IIA: Biocompatibility by Lardes Biosciences Publishers, 2003.
6. Kewal K. Jain, The Handbook of Nanomedicine, Humana Press, 2008.
7. Coombs RRH, Robinson DW. Nanotechnology in Medicine and the Biosciences, 1996, ISBN 2-88449-080-9.

14CH3010 POLYMERS FOR NANOTECHNOLOGY

Credits: 3:0:0

Objective:

- To teach the basic knowledge about the polymers
- To study the concept of nanotechnology applied in polymer technology
- To have an basic idea about the nano composites

Outcome:

- Students would be able to understand the basic concepts of the polymers.
- They would be able to formulate and develop new polymer nano-composites for various industrial applications
- They would be trained in the fabrication of Polymer nano composites

Course Description:

Introduction to material – metal, polymer and ceramic- Conventional composite –particle filled, long and short fibre and fabric reinforced- Introduction to Nanocomposites - advantages and limitations of nano-fillers; surface treatment on nano-fillers- Fabrication of polymer nano-composites - compounding and moulding techniques - Tribology of polymer nanocomposite – Introduction to friction, wear and lubrication; advantages of polymers over metal; tribology of conventional polymer composites; tribology of polymer Nanocomposites- Influence of the size of the reinforcing filler on the wear mechanism-Applications of polymeric Nanocomposites in various fields

Reference Books:

1. Paulo Davim, J. (Ed.), "Tribology of Nanocomposites", Materials Forming, Machining and Triobology Series, Paulo Davim, J. (Ed.), Springer, 2013.
2. Paipetis, A. S. And Kostopoulos, V. (Ed.), "Carbon Nanotube Enhanced Aerospace Composite Materials", Solid Mechanics and its Applications Series, Gladwell, G. M. L. (Ed.), Springer 2013.
3. Mai, Y. W. And Yu, Z. Z., "Polymer Nanocomposites", Woodhead Publishing Ltd., Cambridge, England, 2006.
4. Peter C LeBaron, Wang Z. and Pinnavaia, T. J., "Polymer layered silicate Nanocomposites: an overview", "Applied Clay Science", vol.15, pp11-29, 1999.
5. Ma, P, Siddiqui, N. A., Marom, G. And Kim, J, "Dispersion and functionalisation of carbon nanotubes for polymer based Nanocomposites: a review", Composites: Part A, vol. 41, pp 1345- 1367 2010.
6. Anil Kumar and Rakesh K. Gupta, "Fundamentals of polymer engineering" Tata McGraw Hill Publication Ltd., New Delhi, 2003 (revised and expanded edition)
7. R.J. Young, P.A. Lovell, "Introduction to polymers" Stanley Thomas Publishers, London, 2000

14CH3011 TECHNICAL TEXTILES

Credits: 3:0:0

Objective:

- To impart basic knowledge on fibre science
- To make the students understand the processing of textiles
- To make the students realize the need for smart textiles

Outcome:

- The student will acquire basic knowledge on fibre science
- The student will understand the interaction of fibres with dyes and finishes.
- The student will realize the need for nanotechnology in the field of textile chemistry (smart textiles)

Course Description:

Introduction to natural and synthetic fibres – properties and processing – preparation, mercerization, dyeing, printing and finishing – coatings and laminates, Chemical modification of fibres and fabrics for different end uses – Chemistry of dyes and intermediates, Testing of textile materials for various mechanical and structural properties -

Smart textiles – self-cleaning fabrics, antibacterial finish with nano particles, anti shrink, wrinkle free, flame retardant, conductive textiles, textile based sensors, medical textiles, wound care materials, water proof and breathable fabrics, geotextiles.

Reference Books:

1. S. P. Mishra, A Textbook of Fibre Science and Technology, New Age Publishing Ltd., New Delhi, 2000.
2. J. E. Booth, Principles of Textile Testing, Chemical Pub. Co., 1969.
3. J. E. McIntyre, Synthetic Fibres: Nylon, Polyester, Acrylic, Polyolefin, CRC Press, 2005
4. Choudhary, Textile Preparation and Dyeing, Science Publishers, USA , 2006.
5. Elliot B. Grover ,Handbook of Textile Testing and Quality Control, T**extile Book** Publishers (Interscience), New York, 1960
6. Venkatraman, Chemistry of synthetic dyes, Academic press, London, 1971.
7. A R. Horrocks, Hand book of Technical textiles, Wood Head Publishing Ltd., USA, 2004.

14CH3012 METALS IN BIOLOGY

Credits: 3:0:0

Objective:

- To explain the importance of role of metals in biology
- To get thorough knowledge about various function of metals in various real system
- To expose the students to model compounds

Outcome:

- The students will know the importance of trace elements in biology
- Students will have the knowledge functions of metals in various real systems
- The students will know about mimicking nature for the benefit of mankind

Course Description:

Inorganic composition of cells – Trace elements in biology – Bioinorganic chemistry of iron -Dioxygen binding, transport and storage – Electron transfer – Ferredoxins – Rubridoxins – cytochromes - Blue copper proteins – bioorganometallic chemistry - Hydrogenases – Hydrogen energy - Vitamin B12 and B12 coenzymes – enzymes classification - Zinc, Iron and Magnesium enzymes - Molybdenum and tungsten enzymes - Nitrogen cycle - Medicinal Chemistry – Anticancer drugs – examples - Antibiotics and drugs – examples - Imaging

Reference Books:

1. Huheey J. E, Keiter E. A & Keiter R. L, "Inorganic Chemistry – Principles of structure and reactivity", Dorling Kindersley (India) Pvt. Ltd, New Delhi, India, 4th edition, 2009.
2. Shriver & Atkins, "Inorganic Chemistry", Oxford University Press, New Delhi, India, 4th edition, 2009.
3. Greenwood N. N. & Earnshaw A, "Chemistry of the Elements", Reed Elsevier India Private Ltd, Gurgaon, India, 2nd edition, Reprinted 2010.
4. K. Hussain Reddy, BIOINORGANIC CHEMISTRY, New Age International Ltd, 2003
5. Bertini I, Gray H. B, Lippard S. J & Valentine J. S, "Bioinorganic Chemistry", Viva Books Private Ltd, New Delhi, India, 2007.
6. Stephen j. Lippard;jeremy m. Berg, principles of bioinorganic chemistry, panima publishing corporation, 2005
7. Hanson, Graeme; Berliner, Lawrence (Eds.), Metals in Biology, Springer, 2010