COMPLEMENTARY COURSE- CHEMISTRY FOR FIRST DEGREE PROGRAMME IN INDUSTRIAL MICROBIOLOGY

COURSE TITLE	Hrs/ week	Total Hrs	Credit
Semester I			
IM 1131.7: Basic Theoretical and Analytical Chemistry	3	54	3
Chemistry Lab	2	36	No ESE
Semester II			
IM 1232.7: Physical Chemistry	3	54	3
Chemistry Lab	2	36	No ESE
Semester III			
IM 1333.7: Bioorganic Chemistry	3	54	3
Chemistry Lab	2	36	No ESE
Semester IV			
IM 1434.7: Bioinorganic & Electro Chemistry	3	54	3
Chemistry Lab	2	36	4
Total			16

SEMESTER -1

COMPLEMENTARY COURSE
BASIC THEORETICAL AND ANALYTICAL CHEMISTRY
COURSE CODE IM1131

CREDIT -3

Lecture - tutorial- lab-3-0-2, Eighteen 5 days per week per semester

Contact hours per semester- 54 hours lecture and 36 hours practical

Aim of the course: Aim of the course is to study the basic ideas of chemistry that are essential for the better understanding of important concepts and developments in biochemistry and microbiology

Objective of the course:

On completion of the course student will be able to understand the basic ideas of atomic structure, chemical bonding and nuclear chemistry.

To understand the basic principles of volumetric analysis

To develop interest in spectroscopic methods of analysis and creating scientific awareness of environmental chemistry

Course outline

Module 1. Atomic structure **(9 hours)**

Postulates of Bohr Theory- (no derivation)-Debroglie relation- problems- Uncertainity principle- Schrodinger wave equation(no derivation) – radial and angular probability- shape of orbitals- Paulis exclusion principle- Aufbau principle- Hunds rule- stability of Half filled and fully filled orbitals.

Module II Chemical bonding **(9 hours)**

Ionic bonding- Born haber cycle- Covalent bond - valence bond theory and - Hubridisation (qualitative explanation only) - VSEPR theory- sp-sp^2-sp^3-sp^3d-sp^3d^2 hybridiisation-MO theory of homonulear diatomic molecules- polarity and dipole moment- metallic bond- hydrogen bond- hydrogen bonding in biological systems.

Module III Nuclear chemistry **(9 hours)**

Nuclear particles, stability of nucleus,binding energy, packing fraction, n/p ratio. .Natural radioactivity, modes of decay, decay constant, half life period, average life,radioactive equilibrium, units of radioactivity, radiation dosage.Induced radioactivity, nuclear reactions induced by charged projectiles, neutrons and γ rays, fission reactions, fusion reactions transuranic elements, Q values of nuclear reactions. Applications of radioactivity.

Module IV Spectroscopy-I **(9 hours)**

Regions of electromagnetic spectrum-interaction of radiation with matter—various types of molecular spectra-microwave spectroscopy-spectra of diatomic molecules-selection rule-frequency of separation of spectral lines-determination of bond length-

Infra red spectra-selection rule- frequency of separation-calculation of force constant- study of carbonyl and OH region- Hydrogen bonding

Module V Analytical chemistry **(9 hours)**

Solubility-solubility product-common ion effect – application in qualitative analysis-principle of volumetric analysis-primary standard-standard solution-normality and molarity- calculation for

...ction and mixing-theory of acid base, permanganometry-iodometry, iodimetry and ...plexometric titrations- theory of acid base indicators- redox indicators- principle of ...olumetry

Module 6 Environmental Chemistry (9 hours)

...Environmental segments-composition of atmosphere- atmospheric structure-radiation balance- ...green house effect-formation and depletion of ozone layer-air pollution- air pollutants- ...photochemical smog-analysis of oxides of sulphur and particulate matter-BOD-COD-trace ...elements- Soil pollution

References

1. J.D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London
2. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi
3. C.N. R. Rao, University General Chemistry, Macmillan, 3rd edn., John Wiley, 2001
4. R. A. Day Junior, A.L. Underwood, Quantitative Analysis, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988
5. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, 6th edn. Pearson Education (2003)
6. R. Gopalan, Analytical Chemistry, S. Chand and Co., New Delhi.
7. Environmental Chemistry , A.K Day
8. Environmental Science Y.K Singh

SEMESTER II

COMPLEMENTARY COURSE- PHYSICAL CHEMISTRY

COURSE CODE IM1232.7

CREDIT -3

Lecture –tutorial-lab-3-0-2, Eighteen 5 days per week per semester

Contact hours per semester- 54 hours lecture and 36 hours practical

Aim of the course: - Aim of the course is to study the physical chemistry that is essential for learning the physical aspects of biochemical reactions.

Objective of the course:

On completion of the course student will be able to understand the basic ideas of thermodyanamics that is essential for any branch of science and technology.

To understand the basis principles of chemical equilibrium and solutions

To formulate scientific theories of speed of reactions and colloids that are common in life systems

Module I **(9 hours)**

Thermodynamics

First law-intrinsic energy and enthalpy- work done during isothermal expansion- Hess's law-Enthalpy- relation between heat of reaction at constant volume and constant pressure-Calculation of bond energy -second law – conditions for spontaneousity-Entropy and Gibbs energy

Module II **(9 hours)**

Equilibrium

Chemical equilibrium- relation between Kp and Kc- relation between Kc and Kp effect of pressure, concentration, temperature and addition of inert gas on formation of ammonia and decomposition of PCl_5 – Le Chatliers principle and its applications- concept of acids and bases-ionic product of water-pOH, pH- ionization constant of weak acids and bases- Buffer solution-Henderson equation- buffer action

Module III **(9 hours)**

Dilute solutions

Colligative properties- Determination of molecular mass with elevation in boiling point-depression in freezing point- osmotic pressure- relative lowering of vapour pressure- abnormal molecular mass – degree of dissociation and association

Module IV **(9 hours)**

Binary liquid systems

Completely miscible liquid pairs- vapour pressure composition curve- boiling point composition curve-ideal and non ideal solutions-fractional distillation- azeotropic mixtures- CST-phenol-water - nicotine water system-effect of impurities on miscibility and CST

Module V **(9 hours)**

Chemical Kinetics

Order and molecularity-derivation of rate equation for zero, first, second order with same initial concentration- determination of order of reaction-effect of temperature on reaction rate- concept

of activation energy- Arrehinius equation- determination of Arrhenius parameters- intermediates compound theory- adsorption theory of catalysis

Photochemistry-Grothus Draper law-Einstein law-Beer Lambert Law-quantum yield- reason for low and high quantum yield- photosensitization- chemiluminiscence-flourescence-phosphorescence

Module VI

Colloids **(9 hours)**

Classification of Colloids-Properties of Colloids- Tyndall effect- Brownian movement-electrophoresis- electroosmosis- origin of charge and stability of colloids- hardy Schulz rule-protective colloids- gold number- applications of colloids- Cleansing action of detergents and soap. Blood as a colloid

Reference books

1) B.R. Puri, L.R. Sharma & M.S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., Jalandhar.

2) P.L. Soni, O.P. Dharmarha & U.N. Dash, *Text book of Physical Chemistry*, 22nd Edn., Sultan Chand & Sons, New Delhi.

3. R.D.Rastogi, *Introduction to Chemical Thermodynamics*, 6th edition, Vikas Publishing House Pvt Ltd.

4. P.L.Soni & Dharmarh *Text book of Physical Chemistry*, S.Chand & Co New Delhi.

SEMESTER III

COMPLEMENTARY COURSE-BIOORGANIC CHEMISTRY
COURSE CODE IM1333.7

Credit: 3
LECTURE –TUTORIAL-LAB-3-0-2, Eighteen 5 days per week per semester
Contact hours per semester- 54 hours lecture and 36 hours practical

Aim of the course: - Aim of the course is to study the basic structural and chemical aspects of reactions in biological systems
Objective of the course:

On completion of the course student will be able to understand the structure and stereochemical aspects of biomolecules .
To understand the building blocks of carbohydrates, proteins and nucleic acids

Module 1 **(9 hours)**
Carbohydrates
Classification- configuration of tetrose, pentose and hexose- properties and structure of glucose and fructose- ring structure- Haworth structure- anomers- epimers- mutarotaion- interconvesrion of glucose to fructose- mannose to glucose- starch and celluolose- basic ideas of structure and industrial applications.

Module II **(9 hours)**
Polymers
Classification of polymers- natural – synthetic- addition- condensation- step growth- chain growth- copolymer- homopolymer- fiber- elastomer- thermosetting- thermoplastics-examples- Natural and synthetic rubbers- silicones- Polymers in biological systems- basic concept.
Biodegradable polymers- basic concept
Determination of molecular mass- number average and weight average mol mass

Module III **(9 hours)**
Reaction intermediates and electron displacement effects
Homolytic and Heterolytic Bond Fission – Substrate and Reagent – Electrophiles and Nucleophiles – Reaction intermediates – carbocation, carbonion, Free radicals and Carbenes – Their generation, structure and stability – Electron displacement effects – Inductive effect, Electrometric effect, Mesomeric effect, Hyper conjugation effect and Sterric effect – Their Applications.

Module IV **(9 hours)**

Sterochemistry
Classification of Stereo isomers – Geometrical isomers – Cis-trans, E-Z designation – characterization of geometrical isomers – conformation of ethane, n-butane and Cyclohexane Configuration – Wedge formula and Fischer projection formula –Newmann projection formula. Optical isomerism plane polarized light – chirality and elements of symmetry. DL designation and RS designation, Enantiomers, mesoform,erythro and threo forms and diastereoisomers. Racemisation- resolution –Chiral drugs

Module V

Spectroscopy- II **(9 hours)**

Raman spectra- stokes lines- antistokes lines-quantum theory –advantgaes and disadvantages- complemenatary nature of ir and raman-mutual exclusion ^{1}H NMR spectroscopy- principle- chemical shift- Internal standard,δ and T scale,Shielding Effects, Factors affecting Chemical Shift, Spin-Spin Coupling, Interpretations of spectra of hydrocarbons, alcohols, aldehydes, ketones, aliphatic and aromatic compounds.

Module 6 **Chromatography** **9 Hours**

Types of Chromatography (brief study) – Adsorption and Partition Chromatography, Thin Layer Chromatography , Gas chromatography– R_F and R_T value, HPLC, Ion Exchange Chromatography – Applications

Reference

1.Organic Chemistry : I.L. Final Volume 1 and II
2.Organic Chemistry : Pine
3.Advanced Organic Chemistry : Bhal and Bhal
4.A Text Book of Organic Chemistry : Tewari, Mehrothra, Vishnoi
5.Organic reaction mechanism : Raj K Bensal
6. Organic Spectroscopy : Jagmohan

SEMESTER IV

Complementary Course-Bioinorganic and Electro Chemistry
COURSE CODE IM1434.7

Credit -3
Lecture –TUTORIAL-LAB-3-0-2, Eighteen 5 days per week per semester
Contact hours per semester- 54 hours lecture and 36 hours practical

Aim of the course: - Aim of the course is to study the physical chemistry and bioinorganic chemistry related to life systems

Objective of the course:

On completion of the course student will be able to understand the basic ideas of electrochemistry .

To understand the bioinorganic molecules their structure and functions

Module 1 **(9 Hours)**

Co-ordination Chemistry

Introduction – Double salt and Co-ordination compounds – Werner's Coordination theory, Nomenclature – Isomerism – types of ligands – Electronic interpretation of Werner's theory – EAN rule. Modern theories of M-L bond – valence bond theory – hybridization in tetrahedral, square planar and octahedral complexes – explanation of magnetic properties based on VBT. Crystal field theory, Crystal field splitting ion octahedral, tetrahedral ligand field.

Module II **(9 Hours)**

Bioinorganic compounds

Metalloporphyrins-photosynthesis and respiration-haemoglobin and myoglobin-mechanism of O_2 and CO_2 transportation-nitrogen fixation-carbon fixation-biochemistry of Iron- Trace elements.

Module III **(9 Hours)**

Electrochemistry- I

Equivalent conductance and Molar conductance Effect of Dilution on Conductance-Kohlrausch's Law – applications– The laws of electrolysis – Faraday's law and its significance – Transference Number – Determination by Hittorf's method and moving boundary method-conductometric titrations

Module IV **(9 Hours)**

Electrochemistry- II

Electrochemical cell-Daniell cell – Reversible and Irreversible cell – Single electrode potential – EMF of cells – Standard potential and standard emf – Standard Hydrogen electrode and calomel electrode – Types of electrodes – electrode reaction – cell reaction Nernst equation for electrode potential and emf of the cell – Electrochemical series – – Calculation of ΔG, ΔH, ΔS and equilibrium constant from emf data – Potentiometric titrations

Module V

Mass Spectrometry **(9 Hours)**

Basic principles, Instrumentation, Fragmentation pathway, Molecular ion-base peak, Meta stable ion, Mc-Lefferty Rearrangement, Mass spectra of alkanes, cyclo alkanes, saturated alcohols and aliphatic ketones

Module 6

Mechanism of Organic reactions **(9 Hours)**

Nucleophilic Substitution in alkyl halides – SN1 and SN2 mechanism – Effect of structure on SN1 and SN2 as illustrated by Primary, Secondary and Tertiary alkyl halides and Benzyl halides – Stereo Chemistry of SN1 and SN2 reaction – Mechanism of Electrophilic addition of Hydrogen halides to Carbon – Carbon double bond. Markownikoff's rule – Peroxide effect (Free radical addition of HBr on unsymmetrical double bond. Elimination – E1 and E2 mechanism – Mechanism of dehydration of alcohol and dehydrohalogenation of alkyl halides – Saytzef's rule and Hofmann's rule-aromatic electrophilic Substitution. Halogenation, Nitration, Sulphonation, Friedel Craft's alkylation and acylation – Aromatic nucleophilic substitution – SN Ar and Benzyne Mechanism

Reference

1.Organic Chemistry : I.L. Finar Volume 1 and II
2.Organic Chemistry : Pine
3.Advanced Organic Chemistry : Bhal and Bhal
4.Advanced Organic Chemistry : Jerry March
5.A Guide to mechanism in Organic Chemistry : Peter Sykes
6.Organic reaction mechanism : Raj K Bensal
7.Physical Chemistry : Puri, Sharma and Pathania
Physical Chemistry : WJ Moose
8. *Text book of Physical Chemistry*, P.L. Soni, O.P. Dharmarha & U.N. Dash,
9. Gurudeep R. Chatwall, *Principles of Inorganic Chemistry*.

SYLLABUS OF CHEMISTRY LAB COURSE

(144 Hours, Credit 4)

Organic Qualitative Analysis

1. **ESE only at the end of fourth semester**
2. **Minimum ten volumetric analysis should be done and recorded**
3. **Electronic balance is preferred for all weighing experiments**

Qualitative analyses with a view to characterize monofunctional groups in the following compounds with identification and confirmation of

Detection of elements

saturation and unsaturation

Aromatic and aliphatic

Functional group

Napthalene, chlorobenzene benzyl chloride, benzyl alcohol, phenol, benzaldehyde, acetophenone, benzophenone, benzoic acid, cinnamic acid, succinic acid, salicylic acid, ethyl benzoate, benzamide, urea, aniline, , glucose,

Note : Minimum ten compounds should be analyzed and recorded.

b. Preparation of organic compounds (No ESE for preaparation)

1. preparation of urea nitrate
2. Preparation of phenyl benzoate
3. Preparation of phenyl benzamide
4. preparation of 2,4,6-Tribromoaniline
5. Preparation of p-nitroacetanilide

1. **ACIDIMETRY AND ALKALIMETRY**

a. Estimation of NaOH using standard Na2 CO3 (two burette method).

b. Estimation of HCl using standard oxalic acid (two burette method).

C Estimation of NaOH using standard HCl

2. **PERMANGANOMETRY**

a. Estimation of oxalic acid – using standard Mohr's salt (Two burette method).

b. Estimation of Fe^{2+} using standard oxalic acid (two burette method).

3. **DICHROMETRY**

a. Estimation of Fe^{2+} - External indicator.

b. Estimation of Fe^{2+} using internal indicator.

4. **IODOMETRY AND IODIMETRY**

a. Estimation of Cu^{2+}/CuSO4.5H2O

b. Estimation of Potassium dichromate/Cr^{3+}.

5. **COMPLEXOMETRY**

a. Estimation of Mg^{2+}

b. Estimation of Zn^{2+}