B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTL105
Chemistry-I (Inorganic Chemistry)

Time: 3 Hours **Max. Marks: 40**
Periods/week: 4 **Theory: 30; Int. Ass.: 10**

Note for the paper setters/examiners:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A
Introduction, Werner's coordination theory, naming of co-ordinate complexes.
Co-ordination numbers 1-12. Factors affecting co-ordination numbers and stereo-chemistry, Isomerism in coordination compounds.

Section-B
Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, electro-neutrality and back bonding, limitations of V.B. theory.

Section-C
Stability of co-ordination compounds
Introduction Factors affecting the stability of metal ion complexes with general ligands
Alkali metal and alkaline earth metal chelators : Definition and few examples of macrocyclic ligands, macrocyclic effect, crown ethers &cryptands.

Section-D
Crystal field theory-Spliting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands, calculations of C.F.S.E. in high spin and low spin octahedral and high spin tetrahedral complexes, factors affecting the 10 Dq value.
Spectroscopic terms for d^1-d^2 electronic configurations.

Books Recommended:

1. G.L. Eichorn, Inorganic Biochemistry, Vol. I Elsevier,
2. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, 4th ed. Pearson Education, Singapore, 1999.
3. D.F.C Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, ELBS Oxford, 1991.
4.Cowan, J.A. (1997) – Inorganic Biochemistry – An Introduction, Wiley- VCH

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTP125

Chemistry-I (Inorganic Chemistry) Lab

Time: 3 Hours **Max. Marks: 20**

Periods/week: 4 **Practical : 15; Int. Ass.: 05**

Note. The question paper will be set by the examiner based on the syllabus

-Volumetric Analysis:

Iodimetry, Iodometry, Redox titrations using $K_2Cr_2O_7$ and KM_nO_4.

Complexometric titration using EDTA Ca^{2+},Mg^{2+}: in context with study of hardness of water.

Inorganic qualitative analysis:

Four ions (Two cations two anions).

A. Preliminary tests: Physical examination, Dry heating test, charcoal cavity test,

$Co(NO_3)_2$ test, flame test, borax bead test.

B. Acid radical analysis: metal ions

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-III)

BT-301
Physical Chemistry – A

Time: 3 Hrs. **Max.Marks:30+10 (Internal Assessment)**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 6 very short answer type questions are to be set, from whole syllabus, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 6 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

Unit-I

Chemical Thermodynamics:

State of a system, state variables, thermodynamic equilibrium, thermodynamic properties, Intensive and Extensive properties, various types of processes. First Law of Thermodynamics, internal energy and enthaply, change in internal energy and change in enthalpy for expansion of real and ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes. Relation between Cp and Cv. Internal energy change and enthaply change in a chemical process.Hess's law of heat summation.Enthaply of formation, enthaply of ionisation and calculation of bond dissociation energies from thermochemical data.

Unit-II

Second law of thermodynamics, entropy and Gibb's free energy, Carnot's cycle, Calculation of entropy change for reversible and irreversible processes under isothermal and non-isothermal conditions.GibbsHemholtzequation.Third law of thermodynamics, Nernst heat theorem, calculation of absolute entropies of substances.Meaning of chemical equilibrium, homogeneous and heterogeneous equilibria. Thermodynamic derivation of law of chemical equilibrium, Van't Hoff relation, Relation between free energy change and equilibrium constants KpKc and Kf. Temperature and pressure dependence of equilibrium constant.

Unit-III

Solutions:

Definition, types of solutions,Molarity, molality, normality, mole fraction, mass fraction,vapour pressure of solution and Raoult's law. Factors influencing the solubility of gas in liquids, Henry's law.Ideal solutions, DuhemMargulesequation.Distillation of ideal solutions, Lever rule, vapour pressure of ideal solutions and non idealsolutions.Distillation of non idealsolutions.Azeotropes, colligative properties, lowering of vapour pressure, depression in freezing point, elevation in boiling point, osmotic pressure. Their common features and applications.Thermodynamic derivation of elevation in boiling point, depression in freezing point and osmotic pressure.Van't Hoff factor and its application to calculate degree of association and degree of dissociation.

Unit-IV

Phase Equilibria:

Definition of phase, component and degree of freedom, Phase rule and its thermodynamic derivation. Derivation of Clausius-Clapeyron equation and its importance in phase equilibria, phase diagrams of water system, KI water system and lead-silver system.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT-301

Physical Chemistry – A Practical

Time: 3 Hrs. **Max. Marks: 15+05(Internal Assessment)**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Surface tension: Determination of surface tension of a given liquid by Stalgometer. Using number of drops and weight of drops methods
2. Determination of coefficient of viscosity of a pure liquid (Acetone, Ethanol, Propanol, Butanol, Glycol) (Effect of hydrogen bonding on viscosity)
3. Photometry.

   Verification of Lambert beer's law for solution of $CoCl_2H_2o$ (in water) and $K_2Cr_2O_7$ (in water)
4. a) pH of buffer solution
   b) Acid base titration HCl vs. NaOH.
   c) Determination of ionization constant of a weak acid (CH_3COOH)
5. Study of distribution law of Benzoic acid between benzene and water.
6. Study of distribution law by iodine distribution between water and CCl_4. Given standar solution $Na_2S_2O_3$.
7. Determine composition of HCl and CH_3COOH in the given solution pH metrically.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT-401

Physical Chemistry – B

Time: 3 Hrs. **Max.Marks:30+10 (Internal Assessment)**

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 6 very short answer type questions are to be set, from whole syllabus, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 6 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

Unit-I

Electrochemical Cells:

Electrode poential, Electromotive force (EMF).Reversible and irreversible cells, measurement of EMF of a cell.Nernstequation.Reference electrodes and other electrodes, standard electrode potential.Activity and activity coefficient determination from EMF results. Concentration cells with transference and without transference, liquid function potential, pH, glass electrode, quinone-hydroquinone electrode, Potentiometric titrations.

Unit-II

Chemical Kinetics:

Rate of reaction, rate constant, factors influencing rate of reaction, order, molecularity. Rate equations for Ist order, IInd order &IIIrd order reactions. Methods for determining order of reaction. Half Life,.Activation energy and calculation from Arrhenius equation. Theories of reaction rates collision theory and transition state theory of biomolecularprocesses.Catalysis, Catalysis, acid base catalysis, enzyme catalysis including their mechanisms, MichaelisMenten equation for enzyme catalysis.Heterogeneous catalysis and its mechanism. Surface reactions with special reference to Unimolecular surface reactions.

Unit-III

Ionic Equilibria and Conductance: Conductivity, equivalent and molar conductance. Variation of equivalent conductance with dilution of weak and strong electrolytes. Arrhenius and Debye Huckel theory. Kohlraush law of independent migration of ions. Transference number and their experimental determination using Hittorf and moving boundary methods. Ionic elocity, ionic mobility. Applications of conductance measurements.

Unit-IV

Determination of degree of ionisation of weak electrolyte, solubility, solubility product of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt, conductometric titrations. Ionic strength. Debye Huckel theory of activity coefficients. Mathematical treatment of multistage equilibria of acids and bases. Salt hydrolysis, calculation of hydrolysis constant, Buffer solutions, Buffer index, Buffer capcity universal buffer preparation. Acid base indicators. Theory of acid base indicators. pH change and selection of indicators in different acid base titrations.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT-401
Physical Chemistry – B (Practical)

Time: 3 Hrs. **Max. Marks: 15+05 (Internal Assesment)**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Refractometry: Determine refractive index of a given liquid as a criterion for its purity. (Benzene i.e. commercial) benzene + A.R. acetone).

2. Polarimetry: Determine the %age composition of an optically active solution.

3. Calorimetry:
   a) Determination of Heat of neutralization
      (i) Strong acid-strong base
      (ii) Weak acid-strong base.
   b) Determination of Heat of solution of KCl, NH_4Cl, KNO_3

4. Conductometry:
   a) Determination of cell constant.
   b) Determination of specific and equivalent conductance of electrolyte (NaCl andHCl).
   c) Precipitation titration of Na_2SO_4 vs. $BaCl_2$.
   d) Neutralization titrations NaOH vs. HCl and NaOH vs. CH_3COOH.

5. Determination of adsorption isotherm of oxalic acid on charcoal.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-507: Physical, Organic & Inorganic Aspects of Spectroscopy-A

Time: 3 Hrs. **Max.Marks:30+10 (Internal Assessment)**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to beattempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

UNIT – I

1. Energy and Electromagnetic Spectrum

Introduction, electromagnetic spectrum and Units, regions of the spectrum, basic features of different spectrometers, statement of Born-Oppenheimer approximation, degree of freedom, Frank Condon Principle, Fluorescence and Phosphorescence.

UNIT – II

II. Ultraviolet and Visible Spectroscopy

The energy of electronic excitation, measurement techniques, Beer-Lambert Law, Molar extinction coefficient. Different types of transition noticed in UV spectrum of organic functional groups and their relative energies. Chromophore, auxochromes, Absorption and intensity shifts, Transition probability. Factors affecting λ_{max} Effect of steric hindrance to coplanarity, Solvent Effects.

UNIT – III

III. Infrared Spectroscopy

Vibrational Energy Levels, Selection Rules, Force Constant, Fundamental Vibration Frequencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, Electronic effect, Bond Angles, Field Effect) of different functional groups. Sampling Techniques.

UNIT – IV

IV. Applications of UV and IR Spectroscopy

Applications of UV spectroscopy, Woodward Fieser rules for calculating λ_{max} of conjugated polyenes and α,ß -unsaturated carbonyl compounds. Applications o f IR spectroscopy, Absorption of Common functional Groups, Interpretation of simple IR spectra, Finger print Regions. Simple numerical problems based on UV and IR spectroscopy.

Books Recommended:

1. Organic Spectroscopy By W. Kemp; Publisher- Palgrave, New York
2. D.H. Williams and I. Fleming. Spectroscopic Methods in Organic Chemistry.
3. Spectrometric Identification of Organic Compounds - R.M. Silverstein & F. X. Webster; Publisher: John Willey and Sons,Inc.
4. Introductory Problems in Spectroscopy- By R.C. Banks, E.R. Matjeha and G. Mercer; Publisher : The Benzamine / Cummings Publishing Company Inc.
5. Introduction to Spectroscopy – D. L. Pavia, G. M .Lampman, and G. S. Kriz Publisher: Brooks / Cole, a part of cengage learning

BT-507 Physical, Organic & Inorganic Aspects of Spectroscopy-A
(Practical)

Time: 3 Hrs. **Max. Marks: 15+05 (Internal Assessment)**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Record of IR spectra of diethyl ether, ethyl acetate and butanone and make its comparisons.

2. Synthesis and electronic spectral studies of d-d bands of $[Ni(NH)_3]Cl_2$ and $[Ni(en)_3]Cl_2$ complexes. A comparison of their electronic spectra with that of $[Ni(H2O)_6]Cl_2$ for the calculation of 10Dq values.

3. Covert cyclohexanone to cyclohexanol and hydrazine of cyclohexanone. Compare the UV-Vis and IR spectra of te products with that of the starting material.

4. Preparation of $[Fe(py)_4(NCS)_2]$ and its IR characterization.

5. Take a commercial sample of methyl orange and record its UV-Vis and florescence spectra under neutral, acidic and basic medium and make comparisions.

6. To verify Beer-Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of given $KMnO_4/K_2Cr_2O_7$

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-607: Physical, Organic & Inorganic Aspects of Spectroscopy-B

Time: 3 Hrs. **Theory : 30**
Periods: 3 **Int. assessment : 10**
Total : 40
Total 40

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

UNIT-I

I. Proton Magnetic Resonance spectroscopy (1H NMR)

The Nuclear spin, Larmor frequency, the NMR isotopes, population of nuclear spin level, spin and spin lattice relaxation. Measurement techniques (CW & FT method), solvent used.

Chemical shift, reference compounds, shielding constant, range of typical chemical Shifts simple application of chemical shifts, Anisotropic effect. Spin spin splitting, Coupling constant.

UNIT-II

II. Applications of NMR spectroscopy

NMR spectra with various examples such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene, o-, m-, p- anisidine, o-, m-, p- nitrophenols, acetophenone. Simple numerical of structure elucidation of NMR spectroscopic data.

UNIT- III

III. Mass Spectrometery

Basic Principles Elementary theory. Molecular ions, isotope ions, fragment ions of odd and even electron types, Nitrogen rule, Factors affecting cleavage patterns, simple cleavage, cleavages at a hetero atom, multicentre fragmentations, rearrangements, diels – alder fragmentation, Mc Lafferty rearrangement.

UNIT- IV

IV. Applications of Mass Spectroscopy

Cleavage associated with common functional groups , Aldehydes, ketones cyclic and acyclic esters, alcohols, olefins, aromatic compounds amines, Interpretation of the spectrum of unknown simple molecules.

Books Recommended:

1. Organic Spectroscopy By W. Kemp; Publisher- Palgrave, New York
2. D.H. Williams and I. Fleming. Spectroscopic Methods in Organic Chemistry.
3. Spectrometric Identification of Organic Compounds - R.M. Silverstein & F. X. Webster; Publisher: John Willey and Sons,Inc.
4. Introductory Problems in Spectroscopy- By R.C. Banks, E.R. Matjeha and G. Mercer; Publisher : The Benzamine / Cummings Publishing Company Inc.
5. Introduction to Spectroscopy – D. L. Pavia, G. M .Lampman, and G. S. Kriz Publisher: Brooks / Cole, a part of cengage learning

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-607 Physical, Organic & Inorganic Aspects of Spectroscopy-B Practical

Time: 3 Hrs. **Practical : 15**
Periods: 4 **Int. assessment: 05**
Total : 20

Note. The question paper will be set by the examiner based on the syllabus.

1. Record the ^{1}H NMR spectra of ethyl acetate and ethyl acetoacetate(in $CDCl_3$ or CCl_4) and show the presence of the tautomeric structures.

2. Preparation of benzillic acid from benzaldehyde.(Green Chemistry Experiment)

3. Separation of components of spinach using column chromatography.

4. Prepare *p*-nitroacetanilde and make comparison of ^{1}H NMR spectral data of aniline, acetanlide(starting material) and *p*-nitroacetanide product.

5. Compare IR and ^{1}H NMR spectra of aspirin and salicyclic acid