B.Sc. Physical Sciences

THREE-YEAR FULL-TIME PROGRAMME
(Six-Semester Course)

COURSE CONTENTS

(Effective from the Academic Year 2010-2011)

UNIVERSITY OF DELHI

DELHI – 110 007

Course Structure

YEAR-1

PART I: Semester – 1

Paper 1	CHPT – 101/ CSPT – 101/ ELPT - 101	Chemistry –I/ Comp Sc –I /Electronics-I
Paper 2	PHPT - 101	Physics-I
Paper 3	MAPT - 101	Maths –I
Paper 4	ENAT 101*/ CSAT 101*	Technical writing and Communication in English / Computational Skills

PART I: Semester – 2

Paper 5	CHPT – 202/ CSPT – 202/ ELPT - 202	Chemistry –II/ Comp Sc –II/Electronics-II
Paper 6	PHPT - 202	Physics –II
Paper 7	MAPT - 202	Maths –II
Paper 8	ENAT 201*/ CSAT 201*	Technical writing and Communication in English / Computational Skills

***The college will have an option to take either of the two papers in a particular semester for a particular course, while students have to appear in both the papers**

In addition, there shall be one qualifying paper in self-learning mode called Environmental Studies offered in Semester-2

YEAR-2

PART II: Semester – 3

Paper 9	CHPT – 303/ CSPT – 303/ ELPT - 303	Chemistry –III/ Comp Sc –III/Electronics-III
Paper 10	PHPT - 303	Physics -III
Paper 11	MAPT - 303	Maths –III
Paper 12	LSPT - 101	Biology-I (Introduction to Biology)

PART II: Semester – 4

Paper 13	CHPT – 404/ CSPT – 404/ ELPT - 404	Chemistry –IV/ Comp Sc –IV/Electronics-IV
Paper 14	PHPT - 404	Physics –IV
Paper 15	MAPT - 404	Maths –IV
Paper 16	LSPT - 202	Biology-II

YEAR-3

PART III: Semester – 5

Paper 17	CHPT – 505/ CSPT – 505/ ELPT - 505	Chemistry –III/ Comp Sc –III/Electronics-III
Paper 18	PHPT - 505	Physics –V
Paper 19	MAPT - 505	Maths –V
Paper 20	CHCT – 501/ CSCT – 501/ ELCT - 501	Concurrent Course-I

PART III: Semester – 6

Paper 21	CHPT – 606/ CSPT – 606/ ELPT - 606	Chemistry –VI/ Comp Sc –VI /Electronics-VI
Paper 22	PHPT - 606	Physics -VI
Paper 23	MAPT - 606	Maths –VI
Paper 24	CHCT – 602/ CSCT – 602/ ELCT - 602	Concurrent Course-II

Semester I

Paper 1

Chemistry –I/ Comp Sc –I /Electronics-I

CHPT-101: Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons

THEORY Marks: 100

Section A: Inorganic Chemistry-1 (30 Lectures)

Unit 1 : Atomic Structure: *Recapitulation of: Bohr's theory de-Broglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure.*

Time independent Schrodinger equation ($H\Psi = E\Psi$). Significance of Ψ and Ψ^2, Schrodinger equation for hydrogen atom. Transformation of Cartesian coordinates (x,y,z) into polar coordinates (r,θ,ϕ). Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. (Only graphical representation), Radial and angular nodes and their significance. Radial distribution functions (1s and 2s atomic orbitals). Significance of quantum numbers, orbital angular momentum and quantum numbers m_r and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Electronic configurations of the atoms. Concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit 2: Chemical Bonding and Molecular Structure

Ionic Bonding : Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Lande equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, bond moment, dipole moment and percentage ionic character.

Covalent bonding :*VB Approach* : Concept of hybridization and VSEPR theory .
Resonance and resonance energy : study of some inorganic and organic compounds.
Molecular Orbital Approach : LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals, non- bonding combination of orbitals ,MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.
Comparison of VB and MO approaches.

Section B: Organic Chemistry-1 (30 Lectures)

Unit 3: Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules : Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule.

Unit 4 : Stereochemistry

Conformations w.r.t. ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds) . Threo and erythro; D and L; *cis - trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit 5: Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons)

Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent.

Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine). Addition of HX (Markownikoff's and anti-Markownikoff's addition). Hydration, Ozonolysis, oxymecuration-demercuration, hydroboration-oxidation

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides, dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$.

Suggested Readings

Section A:

1. J. D. Lee : *A new Concise Inorganic Chemistry*, E L. B. S.
2. James E. Huheey, *Ellen Keiter and Richard Keiter : Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

Section B:

1. I. L. Finar : *Organic Chemistry* (Vol. I & II), E. L. B. S.
2. R. T. Morrison & R. N. Boyd : *Organic Chemistry*, Prentice Hall.
3. Arun Bahl and B. S. Bahl : *Advanced Organic Chemistry,* S. Chand
4. Peter Sykes : *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.

CHPP-101: Practical Chemistry Marks: 50

Section A: Inorganic Chemistry

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1. **Detection of extra elements** (N,S,Cl,Br,I) in organic compounds (containing upto two extra elements)
2. **Separation of mixtures by Chromatography:** Measure the R_f value in each case (combination of two compounds to be given)

a. Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.

b. Identify and separate the sugars present in the given mixture by paper chromatography.

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel , Prentice Hall ,7th Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel , Prentice Hall ,6th Edition.
3. Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
4. Practical Organic Chemistry, Mann F. G. & Saunders B. C, Orient Longman, 1960.

CSPT- 101 –Fundamentals of Programming

THEORY Marks: 100

Programming using C++ : Primitive data types, variables, arithmetic and logical expressions, assignment; input-output methods, control structures, arrays, functions, recursion, pointers, basic file handling

OOPs concepts : procedural abstractions, data abstraction and encapsulation; Inheritance; Polymorphism, Exception handling

BOOKS RECOMMENDED

1. E. Balaguruswamy, **Object Oriented Programming with C++ (4th ed.)**, Tata McGraw Hill
2. H. Schildt, **C++: The Complete Reference Book (4th ed.)**, Tata McGraw Hill
3. H. Schildt, **C++: A Beginner's Guide (2nd ed.)**, McGraw Hill
4. J. R. Hubbard, **Programming with C++ (2nd ed.)**, Schaum's Outlines, Tata McGraw Hill
5. R. Albert and T. Breedlove, **C++: An Active Learning Approach**, Jones and Bartlett India Ltd.

CSPP- 101 Computer Laboratory based on CSPT - 101 Marks: 50

ELPT – 101: Network analysis

THEORY Marks: 100

AC Fundamentals: The Sine wave –Average and RMS values–The J operator – Polar and rectangular forms of complex numbers – Phasor diagram – Complex impedance and Passive networks: Concept of voltage and current sources – KVL and KCL- Application to simple circuits (AC and DC) consisting of resistors and sources - Node voltage analysis and method of mesh currents.**, T-□ conversions.**

Network theorems: Superposition Theorem–Thevenin's Theorem– Norton's Theorem–Maximum power transfer Theorem–Millman Theorem- Reciprocity Theorem

R-L-C Circuits- DC transient Analysis: Circuit transients, source free RL and RC circuits, time constant, driven RL and RC circuits, natural and forced response. RLC circuits, source free RLC, parallel circuit, over damped, critically damped and under damped circuit, source free RLC circuit, complete response of RLC circuit.

R-L-C Circuits- AC Steady State Analysis: Sinusoidal circuit analysis: forced response to sinusoidal functions, phasor.

Instantaneous power, average power, reactive power in R, L and C

Resonance: Series resonance and parallel resonance RLC circuits – Resonant frequency – Q factor – Band width – Selectivity.

Suggested Books:

1. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill.
2. Electric Circuits, S.A. Nasar, Schaum's Outline Series, Tata McGraw-Hill.
3. Basic Circuit Analysis, J. O'Malley, Schaum's Outline Series, Tata McGraw-Hill.
4. Networks, Lines and Fields, J.D. Ryder, Prentice Hall of India.

ELPP -101: Electronics Laboratory Marks: 50

List of Experiments

1.1	(a)To gain familiarity with basic electronic components-(resistors, capacitors, inductors, diodes, transistors). *(b)*To become familiar with the use of analog and digital multimeter for measurement of resistance, current and voltage in different ranges and testing of components
1.2	To gain familiarity with Function Generator and cathode ray oscilloscope and (a) Investigate signal waveforms using an oscilloscope and calibrate frequency (b) Calibrate the Audio Oscillator against main frequency. Measure the phase difference between two independent signals.
1.3	To verify Ohm's Law for a resistor across a power supply for a range of values of R and determine the error as R is increased to mega ohms.
1.4	Verification of Maximum Power Transfer Theorem
1.5	Verification of Thevenin and Norton's Theorem
1.6	Verification of Superposition Theorem
1.7	To study the RC differentiator and study the response to time varying signals
1.8	To study the RC integrator and study the response to time varying signals

Paper 2

PHPT-101: Mechanics

THEORY Marks: 100

Vector Calculus (Total Number of Lectures = 15)

Differentiation of a vector with respect to a scalar. Gradient, divergence, curl and Laplacian operations and their meanings. Idea of line, surface and volume integrals. Gauss's divergence theorem, Stokes theorem and Greens's theorem in a Plane.

Mechanics (Total Number of Lectures = 30)

Dynamics of a system of particles, Centre of mass. Conservation of momentum . Newton's laws, Galilean invariance, Linear Momentum, Impulse. Work–Energy theorem, Potential energy, Conservative and non-conservative forces.
Angular momentum of a particle and system of particles. Torque, Conservation of angular momentum. Rotation about a fixed axis. Moment of inertia and its calculation for rectangular, spherical and cylindrical bodies. Kinetic energy of rotation.
Motion of a particle in a central force field. Kepler's Laws (Only statement).
Elasticity: Hook's Law, Stress, Strain, Elastic Constants, Twisting torque on a wire.

Special Theory of Relativity (Total Number of Lectures = 15)

Constancy of speed of light, Michelson-Morley Experiment, Postulates of Special theory of Relativity, Lorentz transformations, Length contraction and Time dilation, Theorem of Addition of relativistic velocities, Variation of mass with velocity. Equivalence of mass and energy, Doppler effect, Red shift.

REFERENCES:

1. Schaum's Outline of Vector Analysis, 2ed By Murray Spiegel, Seymour Lipschutz (McGraw-Hill, 2009)
2. Mechanics by D.S. Mathur, (S. Chand & Company Ltd., 2000).
3. Mechanics Berkeley physics course, v.1: By Charles Kittel,Walter Knight, Malvin Ruderman,Carl Helmholz,Burton Moyer, (Tata McGraw-Hill, 2007)
4. Physics, Volume I and Vol II by Robert Resnick, David Halliday and Kenneth S. Krane, (John Wiley and Sons Inc., Fifth Edition,1992).
5. Physics for Scientists and Engineers By Raymond A. Serway, John W. Jewett, John W. Jewett, Jr. (Brooks/Cole, 2009)

PHPP-101: Physics Laboratory Marks: 50

Note

A. Each college should set up ALL EXPERIMENTS.
B. Each student is required to perform atleast 6 practicals in each semester.

1. Determination of acceleration due to gravity using Kater's Pendulum.
2. Determination of the acceleration due to gravity using bar pendulum.
3. Determination of moment of inertia of a Fly wheel.
4. Determination of frequency of an electrically maintained tuning fork by Melde's experiment.
5. Determination of the coefficient of Viscosity of water by capillary flow method (Poiseuille's method).
6. Study of the condition of resonance for a series LCR circuit and determine its resonance frequency and Quality factor.
7. Single slit diffraction using laser.
8. Verification of Malus Law.
9. To determine the modulus of rigidity of a wire by Maxwell's needle.
10. To determine the elastic constants of a wire by Searle's method.
11. To study the motion of a spring and calculate (a) spring constant and (b) the value of g.
12. Q factor of a mechanical oscillator.

References:

1) Advanced Practical Physics; Worsnop and Flint, Methuen & Co., London,
2) Advanced Level Practical Physics; Nelson and Ogborn; English Language Book Society.
3) Indu Prakash vol 1 and 2

Paper 3

MAPT-101: Calculus and Matrices

THEORY Marks: 100

Unit I. Matrices (20 L)

R, R2, R3 as vector spaces over R . Standard basis for each of them. Concept of Linear Independence and examples of different bases. Subspaces of R2, R3. Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations.Interpretation of eigenvalues and eigenvectors for such transformations and eigenspaces as invariant subspaces. Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Unit II. Calculus (34 L)

Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. For instance, the sequence arising from Tower of Hanoi game, the Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits. Convergence of a sequence and algebra or convergent sequences. Illustration of proof of convergence of some simple sequences such as (–1)n/n, I/n2, (1+1/n)n, sin n/n, xn with $\tilde{x}$< 1. Graphs of simple concrete functions such as polynomial, trigonometric, inverse trigonometric, exponential, logarithmic and hyperbolic functions arising in problems or chemical reaction, simple pendulum, radioactive decay, temperature cooling/heating problem and biological rhythms. Successive differentiation. Leibnitz, theorem. Recursion formulae for higher derivative. Functions of two variables. Graphs and Level Curves of functions of two variables. Partial differentiation upto second order. Computation of Taylor's Maclaurin's series of functions such as ex, log(1 + x), sin (2x), cos x. Their use in polynomial approximation and error estimation.Formation and solution of Differential equations arising in population growth, radioactive decay, administration of medicine and cell division.

Unit III. (L14)

Geometrical representation of addition, subtraction, multiplication and division of complex numbers. Lines half planes, circles, discs in terms of complex variables. Statement of the Fundamental Theorem of Algerbra and its consequences, De Moivre's theorem for rational indices and its simple applications.

Suggested Readings:

1. George B. Thomas, Jr., Ross L. Finney : Calculus and Analytic Geometry, Pearson Education (Singapore); 2001.
2. T.M. Apostal : Calculus, vol. 1, John Wiley and Sons (Asia) : 2002.
3. A.I. Kostrikin: Introduction to Algebra, Springer Verlag, 1984.

Using computer aided software for example, Matlab/ Mathematica/ Maple/ MuPad/ wxMaxima for operations of complex numbers, plotting of complex numbers, matrices, operations of matrices, determinant, rank, eigenvalue, eigenvector, inverse of a matrix, solution of system of equations

Semester 1/II

Paper 4/8

ENAT 101/201 - TECHNICAL WRITING AND COMMUNICATION IN ENGLISH

Marks: 100

Unit 1
Communication: Language and communication, differences between speech and writing, distinct features of speech, distinct features of writing.

Unit 2
Writing Skills; Selection of topic, thesis statement, developing the thesis; introductory, developmental, transitional and concluding paragraphs, linguistic unity, coherence and cohesion, descriptive, narrative, expository and argumentative writing.

Unit 3
Technical Writing: Scientific and technical subjects; formal and informal writings; formal writings/reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided.

SUGGESTED READINGS

1. M. Frank. Writing as thinking: *A guided process approach, Englewood Cliffs,* Prentice Hall Reagents.
2. L. Hamp-Lyons and B. Heasely: Study Writing; *A course in written English.* For academic and professional purposes, Cambridge Univ. Press.
3. R. Quirk, S. Greenbaum, G. Leech and J. Svartik: *A comprehensive grammar of the English language*, Longman, London.
4. Daniel G. Riordan & Steven A. Panley: *"Technical Report Writing Today"* - Biztaantra.

Additional Reference Books

5. Daniel G. Riordan, Steven E. Pauley, Biztantra: *Technical Report Writing Today*, 8th Edition (2004).
6. *Contemporary Business Communication*, Scot Ober, Biztantra, 5th Edition (2004).

Semester 1/II

Paper 4/8

CSAT 101/201– Computational skills

THEORY Marks: 100

Computer Fundamentals

Introduction to Computers : Characteristics of Computers, Uses of computers, Types and generations of Computers

Basic Computer Organization - Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices

User Interface with the Operating System, System Tools

Data Representation

Binary representation of integers and real numbers, 1's Complement, 2's Complement, Addition and subtraction of binary numbers, BCD, ASCII, Unicode;

Networks terminology

Types of networks, router, switch, server-client architecture

Multimedia

Introduction, Characteristics, Elements, Applications

Problem Solving

Notion of algorithms, stepwise methodology of developing an algorithm, developing macros in spreadsheet

General Awareness (4)

IT Act, System Security (virus/firewall etc. ***I-Tax, Reservations, Banking,***

[1] V Rajaraman, **Fundamentals of Computers,** Fourth Edition, PHI.

[2] Anita Goel, **Fundamentals of Computers;** Forthcoming title in Pearson-Education

Note: Use of Open Office/Star Office is recommended as the s/w is freely downloadable. Open Office available at: http://www.openoffice.org

Star Office available at: http://www.sun.com/software/staroffice/

CSAP 101/201: COMPUTATIONAL SKILLS

PRACTICALS Marks: 50

1. Defined projects will be done by the students and evaluated by the instructor.
2. Document Preparation
3. Presentation Software
4. Familiarizing with the Operating System, Control Panel, Networking Configuration, Firewall setting
5. Spreadsheet Handing, Working with worksheets, Creating a spreadsheet, entering and formatting information, basic functions and formulas, creating charts, tables and graphs.

Semester II

Chemistry –II/ Comp Sc –II/Electronics-II

Paper 5

CHPT-202: Thermodynamics, Equilibria & Functional Group Organic Chemistry-1

THEORY Marks: 100

Section A: Physical Chemistry-1 (30 Lectures)

Unit 1: Chemical Thermodynamics

What is thermodynamics? State of a system, state variables, intensive and extensive variables, concept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes. First Law of thermodynamics.

Calculation of work (w), heat (q), changes in internal energy (ΔU) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w, q, ΔU and ΔH for processes involving changes in physical states.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Various statements of Second Law of thermodynamics, concept of entropy, Gibbs free energy and Helmholtz energy, Calculations of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity. Gibbs – Helmholtz equation. Maxwell's relations. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit 2: Chemical Equilibrium

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and $\Delta G^{\ominus}$, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases.

Unit 3: Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Section B: Organic Chemistry-2 (30 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Unit 4. Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions : (Case benzene) : Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation). (Upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (Upto 4 carbons on benzene).

Unit 5. Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN_2, SN_1 and SN_i) reactions. *Preparation:* from alkenes *and* alcohols. *Reactions:* hydrolysis, nitrite & nitro formation, nitrile & iso-nitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. *Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).
Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit 6: Alcohols, Phenols and Ethers (Upto 5 Carbons)
Alcohols: *Preparation:* Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions:* With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acid. dichromate, con. HNO_3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.
Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.
Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer - Tiemann Reaction, Gattermann-Koch Reaction, Houben – Hoesch Condensation, Schotten – Baumann Reaction
Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Unit 7: Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde , acetone and benzaldehyde) *Preparation:* from acid chlorides and from nitriles. *Reactions* – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

Suggested Readings

Section A:

1 Barrow, G. M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Mahan, B. H. *University Chemistry* 3rd Ed. Narosa (1998).

Section B:

1. I. L. Finar : *Organic Chemistry* (Vol. I & II), E. L. B. S.
2. R. T. Morrison & R. N. Boyd : *Organic Chemistry*, Prentice Hall.
3. Arun Bahl and B. S. Bahl : *Advanced Organic Chemistry,* S. Chand
4. Peter Sykes : *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.

CHPP-202: Chemistry Laboratory Marks: 50

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Section B: Organic Chemistry

1. **Purification** of organic compounds by crystallization (from water and alcohol) and distillation.
2. **Criteria of Purity**: Determination of melting and boiling points.
3. **Preparations**: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
   a. Bromination of Phenol/Aniline
   b. Benzoylation of amines/phenols
   c. Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

Suggested Readings

1. Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
2. Practical Organic Chemistry, Mann F. G. & Saunders B. C, Orient Longman, 1960.
3. Senior Practical Physical Chemistry, B.D.Khosla, R. Chand & Co.

CSPT - 202 :Data Structures

THEORY Marks: 100

Stacks : Definition of stack, array implementation of stack, conversion of infix expression to prefix, postfix expressions, evaluation of postfix expression

Queues : Definition of Queue, circular queues, priority queues, array implementation of queues

Linked lists : Linked List and its implementation, Link list implementation of stack and queue, Circular and doubly linked list

Trees : Intro to trees, Binary search tree, preorder, postorder and inorder traversal

Searching and sorting : Insertion sort, selection sort, bubble sort, merge sort, Linear Search, binary search, Complexity Analysis of searching and sorting algorithms

References :

[1] Y. Langsam, M.J.Augenstein, A.M.Tanenbaum Data Structures using C and C++ , Second edition, Pearson Education

[2] Sartaj Sahni, Data Structures, algorithms and applications in C++, McGraw Hill

[3] Adam Drozdek, Data Structures and Algorithms in C++, Second edition, Vikas Publishing House

CSPP - 202: DATA Structure Lab Marks: 50

Practicals based on CSPT - 202

ELPT – 202: Analog Circuits

THEORY Marks: 100

Diode Circuits: Diode as a circuit element, positive, negative and biased clipper circuits, clamping circuits. Power Supplies: Rectifiers– Halfwave, fullwave and bridge rectifiers- Efficiency- Ripple factor- Shunt Capacitor Filter-Regulation

Transistor Circuits: Bipolar Junction Transistor (BJT): PNP and NPN transistors–current components in BJT – BJT static characteristics (Input and Output) – Early effect- CB, CC,CE configurations (cutoff, active, and saturation regions). Biasing and load line analysis – self bias arrangement.

Small signal analysis of the CE amplifier. Qualitative study of the frequency response of CE amplifier. Definition of Class A, Class B and Class C amplifiers. Analysis of Class B push-pull amplifiers (efficiency, power dissipation).

Field Effect Transistor (FET): Structure and working of JFET and MOSFET – output and transfer characteristics Advantages of FET over BJT.

The Operational Amplifiers: Ideal operational amplifier, inverting amplifier, summing amplifier, non-inverting amplifier, integrator and differentiator

Suggested Books:

1. Electronic Devices and Circuits, D. R. Cheruku and B.T. Krishna, Pearson Education Asia.
2. Op-Amps and Linear Integrated Circuits Technology, R.A. Gayakwad, Prentice Hall of India.
3. Electronic Principles, A.P. Malvino, Tata McGraw-Hill.
4. Integrated Electronics, Analog and Digital Circuits and Systems, J. Millman and C.C. Halkias, Tata McGraw-Hill.
5. Electronic Devices and Circuits, J. Millman and C.C. Halkias, Tata McGraw-Hill.
6. Electronic Devices and Circuits, J.J. Cathey, Schaum's Outline Series, Tata McGraw-Hill
7. Discrete and Integrated Circuit Electronics, Donald P. Leach, Saunders College Publishing

ELPP – 202: Electronics Laboratory **Marks: 50**

2.1	To investigate the I-V characteristics of (a) Tungsten bulb, (b) Solar Cell
2.2	To investigate the I-V characteristics of Silicon and Zener Diode
2.3	To study a semiconductor power supply of given rating using (a) half wave and (b) full wave bridge rectifier circuits; investigate the affect of introducing C-filter; and study voltage regulation
2.4	To study IV- Characteristics of FET
2.5	To investigate the transistor characteristics of a common-emitter circuit
2.6	To investigate the transistor characteristics of a common-base circuit
2.7	To study an amplifier of given gain using Op-Amp in inverting and non- inverting configurations.
2.8	To study Integrator circuit with Op-Amp
2.9	To study Differentiator circuit with Op-Amp

Paper 6

PHPT-202: Thermal Physics

THEORY Marks: 100

Thermodynamics (Number of Lectures = 35)

Thermodynamic Description of system**:** Zeroth law and thermodynamic temperature. First law and internal energy, conversion of heat into work, reversible and irreversible processes, Second law and Entropy, Carnot's cycle and theorem, entropy changes in reversible and irreversible processes, Entropy – temperature diagrams and equations**,** Unattainability of absolute zero, third law of thermodynamics

Thermodynamical potentials : Enthalpy, Gibbs and Helmholt functions, Maxwell's relations and applications, Joule-Thompson Effect –production of low temperatures; Claussius- Clapreyon Equation

Quantum Theory of Radiation (Number of Lectures = 10)

Planck's law of blackbody radiation. Deduction of Wien's radiation formula, Rayleigh-Jeans Law, Stefan-Boltzmann Law and Wien's displacement law from Planck's law.

Kinetic Theory of Gases (Number of Lectures = 15)

Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path**,** Transport Phenomena : viscosity, conduction and diffusion**.** Law of equi-partition of energy and its application to specific heat of gases; monoatomic and diatomic gases

References**:**

1. A treatise on heat: including kinetic theory of gases, thermodynamics and recent advances in statistical thermodynamics By Meghnad Saha, B. N. Srivastava (Indian Press, 1958)
2. Heat and thermodynamics: an intermediate textbook By Mark Waldo Zemansky, Richard Dittman (McGraw-Hill, 1981
3. Thermodynamics, kinetic theory, and statistical thermodynamics by Francis W.Sears & Gerhard L.Salinger.(Narosa, 1986).
4. Thermodynamics By Enrico Fermi (Courier Dover Publications, 1956)
5. Thermal Physics by Garg, Bansal and Ghosh (Tata McGra-Hill, 1993)
6. Fundamentals of statistical and thermal physics By Frederick Reif (McGraw-Hill, 2004)
7. Elementary Statistical Physics By Charles Kittel (Dover Publication, 2004)
8. Physics, Volume I and Vol II by Robert Resnick, David Halliday and Kenneth S. Krane, (John Wiley and Sons Inc., Fifth Edition,1992).

PHPP-202: PHYSICS LABORATORY Marks: 50

1. Measurement of Voltage, frequency and Phase using CRO.
2. To design an amplifier of a given gain using an Operational Amplifier in Inverting and Non-inverting modes.
3. To Study Op-amp as an adder.
4. Design an astable oscillator of a given specification using timer IC 555.
5. To design basic logic gates OR, AND, NOT XOR using NAND/NOR gate; Verify truth tables.
6. To design (i) Half adder and full adder, and (ii) half subtractor and full subtractor.
7. Determination of RC time constant using charging and discharging of capacitor through a resistance.
8. To construct the RC differentiator and study the response to time varying signal.
9. To construct the RC integrator and study the response to time varying signal.
10. To study the I-V characteristics of (a) resistances (Ohm and mega ohm range) (b) Tungsten bulb (c) diode or solar cell. (d) zener diode.
11. Determination of Planck's constant using LED's.
12. Determination of Boltzmann's constant using semiconductor diode.

References:

1) The Art of Electronics, P. Horowitz and W. Hill, Cambridge University Press, 2nd edition, (Cambridge, 1989).
2) Student Manual for The Art of Electronics, T. C. Hayes and P. Horowitz, Cambridge University Press (Cambridge, 1989).
3) Physics Through Experiments 1, EMF Constant and Varying, B Saraf et. al, Vikas Publishing House Pvt. Ltd. (Delhi, 1992).
4) Operational Amplifiers, George Clayton, Steve Winder and G.B. Clayton, Newnes; 5 edition (April, 2003).
5) Operational Amplified Experiment Manual, G. B. Clayton, Butterworth-Heinemann (May, 1983).
6) Data Converters, G. B. Clayton, Halsted Pr (1982).
7) Digital Design, M. Morris Mano, Morris M. Mano, Pearson Higher Education (1990).
8) Paul B. Zbar and Albert B. Malvino, Basic Electronics (A Text-Lab Manual), Tata McGraw Hill.

Paper 7

MAPT-202: Calculus and Geometry

THEORY Marks: 100

Unit I: Calculus 44

Limit and continuity of a function: (ε,δ and sequential approach. Properties of continuous functions including intermediate value theorem. Differentiability. Darboux's theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy mean value theorem with geometrical interpretations. Uniform continuity. Definitions and techniques for finding asymptotes singular points, concavity, convexity, points of inflexion for functions. Tracing of standard curves. Integration of irrational functions. Reduction formulae. Rectification. Quadrature. Volumes.

Unit III: Geometry and Vector Calculus 24

Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola . Classification of quadratic equations representing lines, parabola, ellipse and hyperbola. Differentiation of vector valued functions, gradient, divergence, curl and their geometrical interpretation. Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Recommended Books

1. H. Anton, I. Bivens and S. Davis: *Calculus*, John Wiley and Sons (Asia) Pte. Ltd. 2002.
2. R.G. Bartle and D.R. Sherbert : *Introduction to Real Analysis* , John Wiley and Sons (Asia) Pte, Ltd; 1982

Use of computer aided software for example, Matlab/ Mathematica/ Maple/ MuPad/ wxMaxima in identifying the singular points, points of inflection and tracing of curves.

Semester III

Chemistry –III/ Comp Sc –III /Electronics-III

Paper 9

CHPT-303: Solutions, Conductance, Electrochemistry and Functional Group Organic Chemistry-2

THEORY Marks: 100

Section A: Physical Chemistry-2 (30 Lectures)

Unit 1: Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapor pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids. Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

Unit 2: Phase Equilibrium

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl3-H2O and Na-K only).

Unit 3: Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

Unit 4: Electrochemistry

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series.

Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

Section B: Organic Chemistry-3 (30 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Unit 5: Carboxylic acids and their derivatives

Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of Esters. Reactions: Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their inter-conversion.

Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Unit 6: Active methylene compounds:
Preparation : Claisen ester condensation. Keto-enol tautomerism. Reactions: Synthetic uses of ethylacetoacetate (preparation of non-hetero molecules having upto 6 carbon).

Unit 7: Amines and Diazonium Salts
Amines (Aliphatic and Aromatic): (Upto 5 carbons)
Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann Vs Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction . Electrophilic substitution (case aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.

Unit 8: Carbohydrates:

Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Suggested Readings

Section A:

1 Barrow, G. M. Physical Chemistry Tata McGraw - Hill (2007).
2. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
3. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998).

Section B:

1. I. L. Finar : Organic Chemistry (Vol. I & II), E. L. B. S.
2. R. T. Morrison & R. N. Boyd : Organic Chemistry, Prentice Hall.
3. Arun Bahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand
4. Peter Sykes : A Guide Book to Mechanism in Organic Chemistry, Orient Longman.

CHPP-303: Chemistry Laboratory Marks: 50

Section A: Physical Chemistry

1. **pH measurements**

a. Measurement of pH of different solutions, like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

b. Preparation of buffer solutions:
(i) Sodium acetate-acetic acid

(ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

2, **Distribution**

Study of the equilibrium of one of the following reactions by the distribution method:

$$I_2\,(aq) + I^-(aq) \rightarrow I_3^-\,(aq)$$

$$Cu^{2+}\,(aq) + x\,NH_3(aq) \rightarrow [Cu(NH_3)_x]^{2+}$$

Section B: Organic Chemistry

Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

1. Nitration of Nitrobenzene
2. Preparation of carboxylic acid by alkaline hydrolysis of ester/amide.
3. Oxidation of alcohol/aldehydes/hydrocarbons to carboxylic acid
4. Osazone from glucose/fructose
5. Amides and anilides from carboxylic acid.
6. Preparation of methyl orange.

Suggested Readings

1. Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
2. Practical Organic Chemistry, Mann F. G. & Saunders B. C, Orient Longman, 1960.
3. Senior Practical Physical Chemistry, B.D.Khosla, R. Chand & Co.

CSPT-303 : COMPUTER SYSTEM ARCHITECTURE

THEORY Marks: 100

Introduction : Logic gates, boolean algebra, combinational circuits, circuit simplification, decoders, multiplexors, registers, memory units and memory hierarchy

Data Representation and basic Computer Arithmetic : Number systems, complements, fixed and floating-point representation, character representation, addition, subtraction, magnitude comparison

Basic Computer Organization and Design : Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt, design of basic computer.

Central Processing Unit : Register organization, arithmetic and logical micro-operations, stack organization, micro programmed control. Instruction formats, addressing modes, instruction codes, machine language, assembly language, input output programming

Input-output Organization : Peripheral devices, I/O interface, Modes of data transfer, direct memory access.

References

1. M. Morris Mano, *Computer System Architecture*, Prentice Hall of India Third edition / Pearson Education 3rd edition.

2. William Stallings, *Computer Organization and Architecture*, Prentice Hall of India.

CSPP-303: COMPUTER SYSTEM ARCHITECHTURE LAB Marks: 50

Practical based on CSPT-303

ELPT – 303: Electronic Instrumentation

THEORY Marks: 100

Measuring Instruments: Fundamentals , DC Ammeter, DC Voltmeter, Ohmmeter (Series and shunt), Multimeter

Digital Voltmeter (Integrating, ramp, sample and hold), Digital Multimeter (Block diagram)

Cathode ray Oscilloscope: Bl ock Diagram , CRT and CRT Circuits (Electrostatic Focusing, Electrostatic Deflection), Vertical deflection, Horizontal deflection , Screens for CRT, Delay line (lumped parameter and distributed parameter), CRO probes , frequency and Phase Measurements, Idea of Special Oscilloscopes (Storage, Sampling)

Basics of Signal Generator: Sweep frequency, Pulse and square wave, Pulse Characteristics

Transducers: Introduction to pressure, temperature and light transducers

Frequency counter and classification (Idea only)

Suggested Books:

1. Albert D. Helfrick, William D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI.
2. A.K. Sawhney , A Course in Electrical and Electronic Measurements and Instrumentation
3. Electronic Instrumentation by H.S. Kalsi, Mc Graw Hill

ELPP – 303 Electronics Laboratory Marks: 50

3.1	To study CRO operations through CRO Trainer kit
3.2	To measure unknown impedance by Wheat-stone Bridge
3.3	To study De Sauty Bridge
3.4	To study photodiode
3.5	To study resistivity variation with temperature for a Thermistor
3.6	To study the IV- Characteristics of solar cell.
3.7	To study Thermocouple
3.8	To design and *study* an astable and monostable oscillator of given specifications using Timer IC 555.

Paper 10

PHPT-303 Waves & Optics

THEORY Marks: 100

Oscillations and Waves (Total Number of Lectures =30)

Simple Harmonic Motion: Simple Harmonic Oscillator, Motion of simple and compound pendlum, Loaded spring, Energy in simple harmonic motion. Superposition of two SHM: (i) collinear SHM of same frequency (ii) collinear SHM of different frequencies – phenomenon of Beats (iii) SHM of same frequency but perpendicular to each other and (iv) Lissajous figures.

Damped Harmonic Motion: Equation of motion, Dead beat motion, Critically damped system, Lightly damped system: relaxation time, logarithmic decrement, quality factor.

Forced Oscillations: Equation of motion, Complete solution, Steady state solution, Resonance, Sharpness of resonance, Quality factor.

Coupled Oscillator: Degrees of freedom, Coupled oscillator with two degrees of freedom; Normal modes; General method of finding normal modes for a system of two degrees of freedom.

Wave Motion: One dimensional plane wave , Classical wave equation, Superposition principle, Standing wave on a stretched string (both ends fixed).

Wave Optics (Total Number of Lectures =30)

Interference: Essential conditions for observing interference; Division of wave front; Young's double slit experiment , colour of thin films, Division of amplitude: Newton's rings.

Diffraction: Fresnel and Fraunhofer diffraction; Fraunhofer Diffraction – single slit (intensity distribution, position of maxima and minima), circular aperture (qualitative). plane diffraction grating, resolving power of grating, Rayleigh's criterion, Fresnel diffraction: half period zone, rectilinear propagation of light, zone plate.

Polarization: Polarization of light (plane polarized light), Double refraction. Law of Malus, Nicol Prism. Polarizing materials, Polarizer, Analyzer. Light propagation in uniaxial crystals.

REFERENCES

1. Fundamentals of optics By Francis Arthur Jenkins and Harvey Elliott White (McGraw-Hill, 1976).
2. Optics by Ajoy Ghatak (Tata McGraw Hill, 2008).
3. Contemporary optics by A.K.Ghatak & K.Thyagarajan.(Plenum Press,1978).
4. Introduction to Optics by Khanna and Gulati.
5. The physics of waves and oscillations by N.K. Bajaj (Tata McGraw-Hill, 1988).
6. Vibrations and waves by A.P.French.(CBS Pub. & Dist., 1987).
7. Optics by B.K. Mathur

PHPP-303: PHYSICS LABORATORY Marks: 50

1. To determine the Coefficient of Thermal Conductivity of Copper by Searle's apparatus.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the Temperature Coefficient of Resistance (α) by Platinum Resistance Thermometer (PRT). Assume $R_t = R_0 (1 + \alpha t)$
4. To draw a calibration curve for a Thermocouple using a Potentiometer.
5. To determine Stefan's Constant.

6. To determine wavelength of sodium light using Fresnel Biprism.
7. To determine wavelength of sodium light using Newton's rings.
8. To determine the Cauchy's constant and dispersive power of a prism using mercury light.
9. To determine the wavelength of Sodium light using plane diffraction grating.
10. To study the polarization of light by reflection and to determine the polarizing angle for air-glass interface.

Suggested Books for Reference

1. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
2. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
3. Nelson and Jon Ogborn, Practical Physics.

Paper 11

MAPT-303: Algebra

THEORY Marks: 100

Groups: Definition and examples of groups, examples of abelian and nonabelian groups: the group Z_n of integers under addition modulo n and the group U (n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GLn (n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions, Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Rings: Definition an examples of rings, examples of commutative and noncommutative rings: rings from number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and C. Field of rational functions.

Vector spaces: Definition and examples of vector spaces. Subspacesand its properties Linear independence, basis, invariance of basis size, dimension of a vector space.

Linear Transformations on real and complex vector spaces: definition, examples, kernel, range, rank, nullity, isomorphism theorems, invertible linear transformations (chatacterizations) Algebra of Linear transformations and matrix of a linear transformation Linear functional over real & complex vector spaces: definition and examples. Use of computer aided software for example, Matlab/ Mathematica/ Maple/ MuPad/ wxMaxima in Linear Transformations, invertible transformations, group of symmetries, rectangle, square and permutation groups

Recommended Books

1. Joseph A Gallian: *Contemporary Abstract Algebra*, fourth edition, Narosa, 1999.
2. George E Andrews: *Number Theory*, Hindustan Publishing Corporation. 1984
3. . C.W. Curtis, *Linear Algebra, an introductory approach*, Springer- Verlag, 1991.
4. . David M. Blotin, *Linear algebra and Geometry*, Cambridge Press, 1979.

Paper 12

LSPT-101- BIOLOGY-I- INTRODUCTION TO BIOLOGY

THEORY Marks: 100

Unit 1. Biological systems, evolution and biodiversity

a. Introduction to concepts of biology **(Ch 1 Campbell) (4 Periods)**

Themes in the study of biology; A closer look at ecosystem; A closer look at cell; The process of Science; Biology and everyday life

b. Evolutionary history of biological diversity **(Ch 25 Campbell) (6 Periods)**

Early earth and the origin of life; Major events in the history of life; Mechanism of Macroevolution; Phylogeny and the tree of life

c. Classifying the diversity of life **(Ch 25 Raven) (8 Periods)**

Kingdoms of Life –Prokaryotes, Eukaryotes, Archaea

d. Darwinian view of life and origin of species **(Ch22, 24 Campbell) (10 Periods)**

Darwin's theory of evolution; The evolution of populations; Concepts of species; Mechanism of speciation

e. Genetic approach to Biology **(Ch 1 Griffiths) (8 Periods)**

Patterns of inheritance and question of biology; Variation on Mendel's Law; The molecular basis of genetic information; The flow of genetic information from DNA to RNA to protein; Genetic Variation; Methodologies used to study genes and gene activities; Developmental noise; Detecting macromolecules of genetics; Model organisms for the genetic analysis; Distinction between Phenotype and Genotype

Unit 2. Chemical context of living systems

a. Chemistry of life **(Ch 2 Campbell) (6 Periods)**

The constituents of matter; Structure of an atom; The energy level of electron; The formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds

b. Water and life **(Ch 3 Campbell) (5 Periods)**

The water molecule is polar; Properties of water; Ionization of water

c. Carbon and life **(Ch 4 Campbell) (5 Periods)**

Organic chemistry-the study of carbon compounds; What makes carbon special? Properties of organic compounds

d. Structure and function of biomolecules **(Ch 5 Campbell) (8 Periods)**

Most macromolecules are Polymers; Carbohydrates act as fuel and building materials; Lipids are group of hydrophobic molecules; Protein have diverse structures and functions; Nucleic acids store and transmit hereditary information

SUGGESTED BOOKS

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.

2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi

3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

LSPP-101 Biology-I - INTRODUCTION TO BIOLOGY Lab. Marks: 50

1. To learn a) use of microscope b) principles of fixation and staining.
2. Preparation of Normal, molar and standard solutions, phosphate buffers, serial dilutions
3. Use of micropipettes
4. Separation of A) amino acids B) chloroplast pigments by paper chromatography.
5. To perform gram staining of bacteria.
6. To study the cytochemical distribution of nucleic acids and mucopolysaccharides with in cells/tissues from permanent slides.
7. To perform quantitative estimation of protein using the Lowry's method. Determine the concentration of the unknown sample using the standard curve plotted.
8. To separate and quantify sugars by thin layer chromatography.
9. To raise the culture of *E. coli* and estimate the culture density by turbidity method. Draw a growth curve from the available data.
10. Isolation of genomic DNA from *E.coli*.

Semester IV

Chemistry –IV/ Comp Sc –IV /Electronics-IV

Paper 13

CHPT-404: Chemistry of s & p block elements, States of Matter and Phase Equilibrium

THEORY Marks: 100

Section A: Inorganic Chemistry-2 (30 Lectures)

Unit I. General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.

***s*- and *p*- Block Elements**

Periodicity in s- and p- block elements, w.r.t. electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mullikan, and Alred-Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

Compounds of *s*- and *p*- Block Elements

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.

Hydrides of nitrogen (NH3, N2H4, N3H, NH2OH)

Oxoacids of P, S and Cl

Halides and oxohalides: PCl3, PCl5, SOCl2 and SO2Cl2

Section B: Physical Chemistry-3 (30 Lectures)

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor. Causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of

coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Suggested Readings

Section A:

1. J. D. Lee : *A new Concise Inorganic Chemistry*, E L. B. S.
2. James E. Huheey, *Ellen Keiter and Richard Keiter : Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

Section B:

1 Barrow, G. M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Mahan, B. H. *University Chemistry* 3rd Ed. Narosa (1998).

CHPP-404: Chemistry Laboratory Marks: 50

Section A: Inorganic Chemistry

Semi-micro qualitative analysis using H2S of mixtures not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb^{2+}, Ag^+, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+,

Anions : CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^-

(*Spot tests should be carried out wherever feasible.*)

Section B: Physical Chemistry

1. **Surface tension measurement** (use of organic solvents excluded)

a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

b) Study of the variation of surface tension of a detergent solution with concentration.

2. **Viscosity measurement** (use of organic solvents excluded)

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

3. **Phase equilibria**

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.

b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.

c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel , Prentice Hall ,7th Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel , Prentice Hall ,6th Edition.
3. Senior Practical Physical Chemistry, B.D.Khosla, R. Chand & Co.

CSPT 404 – Operating Systems

THEORY Marks: 100

Introduction : System software, resource abstraction, OS strategies; Types of operating systems - multiprogramming, batch, time sharing, personal computers & workstations, process control & real time systems.

Operating System Organization : Factors in operating system design, basic OS functions, implementation consideration; process modes, methods of requesting system services – system calls and system programs.

Process Management : System view of the process and resources, initiating the OS, process address space, process abstraction, resource abstraction, process hierarchy, Thread model

Scheduling: Scheduling Mechanisms, Strategy selection, non-pre-emptive and pre-emptive strategies.

Interactive and Cooperating processes, critical section, semaphores,

Memory Management : Mapping address space to memory space, memory allocation strategies, fixed partition, variable partition, paging, segmentation, virtual memory

File Management : Directory structure, basic file operations and their implementation.

BOOKS RECOMMENDED

1. A.S. Tanenbaum, **Modern Operating Systems**, 3rd Edition, Pearson Education.
2. W. Stallings, **Operating Systems**, 5th Edition, Prentice Hall of India.
3. A Silberschatz, P.B. Galvin, G. Gagne, **Operating Systems Concepts**, 8th Edition, John Wiley Publications.

CSPP-404- Operating Systems Lab. Marks: 50

PRACTICALS BASED ON CSPT-404

ELPT – 404: Digital Electronics

THEORY Marks: 100

Number System and Codes: Decimal, Binary, Hexadecimal, Octal, BCD, Conversions, Complements (1's and 2's), Signed and unsigned numbers, addition and subtraction, multiplication and subtraction, Gray Codes

Logic gates and Boolean algebra

Digital Logic Families: RTL, DTL, TTL and ECL, MOS and CMOS, Comparison, Realization of basic gates, Fan In and Fan out, power dissipation and noise Immunity, propagation delay, tri state logic

Combinational logic analysis and design: Standard representation of logic functions (SOP and POS), Minimization Techniques (k Map technique) up to 4 variable

Multiplexers and Demultiplexers, Adder (half and full) and their use as subtractor, Encoder and Decoder , Code Converter(Binary to BCD and vice versa)

Sequential logic design: Latch, Flip flop, S-R FF , J-K FF, T and D type FFs, clocked FFs, registers, Counters (ripple, synchronous and asynchronous, ring, modulus)

A/D and D/A converter

Memories: Memory organization, ROM, RAM (Static and dynamic), PROM, EPROM, EEPROM, EAROM PLA and CCD (Idea only)

Suggested Books:

1. Digital Electronics, Principles and Applications, R.L. Tokheim, Tata McGraw-Hill.
2. Digital Principles, R.L. Tokheim, Schaum's Outline Series, Tata McGraw-Hill.
3. Digital Systems, Principles and Applications, R.J. Tocci and N.S. Widner, Pearson Education Asia.
4. Digital Design, M.M. Mano, Pearson Education Asia.
5. Digital Fundamentals, T.L. Floyd, Pearson Education Asia.
6. Solved Problems in Digital Electronics, S.P. Bali, Sigma Series, Tata McGraw-Hill.
7. Digital Electronics, W.H. Gothmann, Prentice Hall of India.
8. Modern Digital Electronics, R.P. Jain, Tata McGraw-Hill.

ELPP – 404: Electronics Laboratory Marks: 50

List of Experiments

4.1	Verification of Logic gates (AND, OR, NOT, XOR and XNOR)
4.2	To design and Study Half and Full Adder circuit
4.3	To design and Study Half and Full Subtractor circuit
4.4	To design and study Code Converter (Binary to BCD)
4.5	To study RS, JK, JK MS Flip Flop
4.6	To study of Multiplexer circuit and Demultiplexer circuit
4.7	To study counters – ripple and decade
4.8	To study D/A and A/D converter

Semester IV

Paper 14

PHPT – 404 Electricity, Magnetism and Electromagnetic Theory

THEORY Marks: 100

Electrostatics (Number of Lectures = 15)

Electric Field:- Concept of electric field lines and electric flux, Gauss's law (Integral and differential forms), application to linear, plane and spherical charge distributions. Conservative nature of electric field **E**, irrotational field.

Electric Potential:- Concept of electric potential, relation between electric potential and electric field, potential energy of a system of charges. **Energy density in an electric field**. Calculation of potential from electric field for a spherical charge distribution.

Magnetostatics (Number of Lectures = 20)

Concept of magnetic field **B** and magnetic flux, Biot-Savart's law, **B** due to a straight current carrying conductor. Force on a point charge in a magnetic field. Properties of **B**, curl and divergence of **B**, solenoidal field.

Integral form of Ampere's law, applications of Ampere's law: field due to straight, circular and solenoidal currents. Energy stored in magnetic field. Magnetic energy in terms of current and inductance. Magnetic force between two current carrying conductors. Magnetic field intensity.

Ballistic Galvanometer:- Torque on a current loop in a uniform magnetic field, working principle of B.G., current and charge sensitivity, electromagnetic damping, critical damping resistance.

Electromagnetic Induction and Electromagnetic waves (Number of Lectures = 25)

Faraday's laws of induction (differential and integral form), Lenz's law, self and mutual Induction.

Continuity equation, modification of Ampere's law, displacement current, Maxwell's equations in vacuum and dielectric medium, boundary conditions, plane wave equation: transverse nature of EM waves, velocity of light in vacuum and in medium, polarization, reflection and transmission.

Polarization of EM waves, Brewster's angle, description of linear, circular and elliptical polarization.

Reference Books

1. Fundamentals of electricity and magnetism By Arthur F. Kip (McGraw-Hill, 1968)
2. Electricity and magnetism by J.H.Fewkes & John Yarwood. Vol. I (Oxford Univ. Press, 1991).
3. Introduction to Electrodynamics, 3rd edition, by David J. Griffiths, (Benjamin Cummings,1998).
4. Electricity and magnetism By Edward M. Purcell (McGraw-Hill Education, 1986)
5. Electricity and magnetism. By D C Tayal (Himalaya Publishing House,1988)
6. Electromagnetics by Joseph A.Edminister 2nd ed.(New Delhi: Tata Mc Graw Hill, 2006).
7.

PHPP-404: PHYSICS LABORATORY Marks: 50

1. To verify the Thevenin, Norton, Superposition, and maximum power transfer theorem.
2. To determine a low resistance by Carey Foster's bridge.
3. To determine the (a) current sensitivity, (b) charge sensitivity, and (c) CDR of a B.G.
4. To determine high resistance by leakage method.
5. To determine the ratio of two capacitances by De Sauty's bridge.
6. To determine self inductance of a coil by Anderson's bridge using AC.
7. To determine self inductance of a coil by Rayleigh's method.
8. To determine coefficient of Mutual inductance by absolute method.

Suggested Books for Reference

1. ***B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.***
2. ***Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.***
3. ***Nelson and Jon Ogborn, Practical Physics.***

Paper 15

MAPT-404: Differential Equations

THEORY Marks: 100

Ordinary Differential equations

First order exact differential equations. Integrating factors, rules to find and integrating factor. First order higher degree equations solvable for x,y,p=dy/dx. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving an differential equation by reducing its order. Linear homogenous equations with constant coefficients. Linear non-homogenous equations. The method of variation of parameters, The Cauchy-Euler equation. Simultaneous differential equations, total differential equations. Applications of differential equations: the vibrations of a mass on a spring, mixture problem, free damped motion, forced motion, resonance phenomena, electric circuit problem, mechanics of simultaneous differential equations.

Partial Differential Equations

Order and degree of partial differential equations. Concept of linear and non-linear partial differential equations. Formation of first order partial differential equations. Linear partial differential equation of first order, Lagrange's method, Charpit's method. Classification of second order partial differential equations into elliptic, parabolic and hyperbolic throughillustrations only. Applications to Traffic Flow.*Using Computer aided software for example, Matlab/ Mathematica/ Maple/ MuPadcharacteristics, vibrating string, vibrating membrane, conduction of heat in solids, gravitational potential, conservation laws*

Recommended Books

1. Shepley L. Ross: *Differential equations*, Third edition, John Wiley and Sons, 1984

2. I. Sneddon: *Elements of partial differential equations*, McGraw-Hill, International Edition, 1967.

Semester IV

Paper 16

LSPT 202 - BIOLOGY-2

THEORY Marks: 100

Cell and Cellular Processes

Unit 1. Techniques in Biology (Ch 1 Sheeler) (12 Periods)

Principles of microscopy; Light Microscope; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis

Unit 2. Cell as a unit of Life (Ch 6 Campbell) (10 Periods)

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components

Unit 3. Cell Organelles (Ch 15, 16, 17,18,19,20 Sheeler) (22 Periods)

- **Mitochondria:**
  Structure, marker enzymes, composition; mitochondrial biogenesis; Semiautonomous organelle; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA

- **Chloroplast**
  Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA

- **ER, Golgi body & Lysosomes**
  Structures and roles. Signal peptide hypothesis, N-linked glycosylation, Role of golgi in O-linked glycosylation. Cell secretion, Lysosome formation.

- **Peroxisomes and Glyoxisomes:**
  Structures, composition, functions in animals and plants and biogenesis

- **Nucleus:**
  Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

Unit 4. Cell Membrane and Cell Wall (Ch 7 Campbell / Ch 15 Sheeler / Ch 3 Raven) (8 Periods)

The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall

Unit 5. Cell Cycle: Interphase, Mitosis and Meiosis (Ch 12, 13 Campbell) (8 Periods)

Role of Cell division; Overview of Cell cycle; Molecular controls; Meiosis

SUGGESTED BOOKS

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Sheeler, P and Bianchi, D.E. (2006) Cell and Molecular Biology, 3rd edition, John Wiley & sons NY

LSPP 202 - BIOLOGY-2 Laboratory Marks: 50

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber
6. To prepare temporary stained preparation of mitochondria from striated muscle cells /cheek epithelial cells using vital stain Janus green.
7. To prepare temporary stained squash from root tips of *Allium cepa* and to study the various stages of mitosis.
8. Study the effect of temperature, organic solvent on semi permeable membrane.
9. Demonstration of dialysis of starch and simple sugar.
10. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
11. Measure the cell size (either length or breadth/diameter) by micrometry.
12. Study the structure of nuclear pore complex by photograph (from Gerald Karp)

Semester V

Chemistry –V/ Comp Sc –V /Electronics-V

Paper 17

CHPT-505: Chemistry of d-block elements, Quantum Chemistry and Spectroscopy

THEORY Marks: 100

Section A: Inorganic Chemistry-3 (30 Lectures)

Unit 1: Transition Elements (3d series)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanides and actinides: Electronic configurations, Oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

Unit 2:Coordination Chemistry

Valency Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of Nomenclature.

Unit 3:Crystal Field Theory

Crystal field effect, Octahedra symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of Δ. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion. Square planar coordination.

Section B: Physical Chemistry-4 (30 Lectures)

Unit 4: Quantum Chemistry & Spectroscopy

Spectroscopy and its importance in chemistry. Wave-particle duality. Link between spectroscopy and quantum chemistry. Electromagnetic radiation and its interaction with matter. Types of spectroscopy. Difference between atomic and molecular spectra. Born-Oppenheimer approximation: Separation of molecular energies into translational, rotational, vibrational and electronic components.

Postulates of quantum mechanics, quantum mechanical operators.

Free particle. Particle in a 1-D box (complete solution), quantization, normalization of wavefunctions, concept of zero-point energy.

Rotational Motion: Schrödinger equation of a rigid rotator and brief discussion of its results (solution not required). Quantization of rotational energy levels. Microwave (pure rotational) spectra of diatomic molecules. Selection rules. Structural information derived from rotational spectroscopy.

Vibrational Motion: Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels. Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Vibrations of polyatomic molecules. Group frequencies. Effect of hydrogen bonding (inter- and intramolecular) and substitution on vibrational frequencies.

Electronic Spectroscopy: Electronic excited states. Free Electron model and its application to electronic spectra of polyenes. Colour and constitution, chromophores, auxochromes, bathochromic and hypsochromic shifts.

Unit 5: Photochemistry

Laws of photochemistry. Lambert-Beer's law. Fluorescence and phosphorescence. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions. Photoelectric cells.

Suggested Readings

Section A:

1. J. D. Lee : *A new Concise Inorganic Chemistry*, E L. B. S.
2. James E. Huheey, *Ellen Keiter and Richard Keiter : Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

Section B:

1 Barrow, G. M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Mahan, B. H. *University Chemistry* 3rd Ed. Narosa (1998).

CHPP-505: Chemistry Laboratory Marks: 50

Section A: Inorganic Chemistry

1. Estimation of the amount of nickel present in a given solution as
2. Bis(dimethylglyoximato) nickel(II) or aluminium as oximate in a given solution gravimetrically.
3. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
4. Estimation of total hardness of a given sample of water by complexometric titration.
5. To draw calibration curve (absorbance at λ_{max} vs. concentration) for various concentrations of a given coloured compound and estimate the concentration of the same in a given solution.
6. Determination of the composition of the Fe^{3+} - salicylic acid complex / Fe^{2+} - phenanthroline complex in solution by Job's method.
7. Determination of concentration of Na^{+} and K^{+} using Flame Photometry.

Section B: Physical Chemistry

1. **Potentiometric measurements**

a. Strong acid with strong base
b. Weak acid with strong base
c. Mohr's salt with potassium dichromate

2. Conductometric measurements.

a. Determination of the cell constant.
b. Study of the variation of molar conductivity of a strong electrolyte (KCl) and of a weak electrolyte (acetic acid) with concentration.

Conductometric titrations for the following systems

(i) strong acid - strong base (ii) weak acid - strong base

3. **Kinetic studies**

Study of the kinetics of the following reactions by integrated rate method:

a. Acid hydrolysis of methyl acetate with hydrochloric acid, volumetrically or conductometrically
b. Iodide-persulphate reaction.

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel , Prentice Hall ,7th Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel , Prentice Hall ,6th Edition.
3. Senior Practical Physical Chemistry, B.D.Khosla, R. Chand & Co.

CSPT 505: Computer Networks

THEORY Marks: 100

Basic concepts : Components of data communication, standards and organizations

Network Categories : Area Networks (LAN, WAN and MAN), Network Relationships (Client-Server, Peer-to-Peer), Network Topologies (Bus, Ring, Star, Mesh)

Layered Communication Connectivity : Fundamentals of Layered Connectivity, OSI and TCP/IP Models, comparison of models, Network Addressing – Physical and Logical Addresses

Physical Layer : Cabling, Network Interface Card, Transmission Media

Devices- Repeater, Hub, Bridge, Switch, Router, Gateway

Data Link Layer : Framing techniques; Error Control; Flow Control Protocols;

Shared media protocols - CSMA/CD and CSMA/CA.

Network Layer : Virtual Circuits and Datagram approach, IP addressing methods – Subnetting; Routing Algorithms (adaptive and non-adaptive)

Application Layer : Application layer protocols and services - DNS, HTTP, WWW

Network Security : Common Terms, Firewalls, Virtual Private Networks

BOOKS RECOMMENDED:

[1] A.S. Tanenbaum, Computer Networks, 4th Edition, Pearson Education.

REFERENCE BOOKS

1. B.A. Forouzan: Data Communication and Networking, 4th Edition, Tata McGraw Hill.
2. D.E. Comer, Internetworking with TCP/IP, Vol. I, Prentice Hall of India
3. W. Stalling, Data & Computer Communication, Maxwell Macmillan International Edition.
4. D. Bertsekas, R. Gallager, Data Networks, 2nd edition, Prentice Hall of India.

CSPP-505- Computer Networks Lab. Marks: 50

PRACTICALS BASED ON CSPT-505

ELPT – 505: Communication Electronics

THEORY Marks: 100

Introduction : Block diagram of an electronic communication system, modulation and demodulation, electromagnetic spectrum band designations and applications. Waveform spectra and effect of filtering on complex signals.

Analog Modulation: Amplitude Modulation: Frequency spectrum of AM waves, average power, average voltage, modulation index, AM-modulator circuits (collector modulation), AM-demodulator (diode detector), single side band generation and detection.

Angle Modulation: Frequency and phase modulation, frequency spectrum of FM waves, intersystem comparisons (FM and AM), FM generation and detection

Frequency division multiplexing (FDM).

Transmitters and Receivers: Communication channels for AM and FM broadcast, AM and FM transmitter, tuned RF receiver, Superheterodyne receiver.

Pulse Analog Modulation: Sampling Theorem and Nyquist Criterion. Pulse Modulation: pulse amplitude modulation (PAM), pulse width modulation (PWM) and pulse position modulation (PPM). Time division multiplexing (TDM).

Digital Communication: Block Diagram of a PCM system, Qualitative description of noise in PCM systems, concept of ASK, FSK, PSK.

Introduction to Modern Communication Systems: Satellite Communication, Fibre Optic System, Cellular Telephone System

Suggested Books:

1. Analog and Digital Communications, H. Hsu, Schaum's Outline Series, Tata McGraw-Hill.
2. Electronic Communication, L. Temes and M. Schultz, Schaum's Outline Series, Tata McGraw-Hill.
3. Analog and Digital Communication Systems, M.J. Roden, Prentice Hall of India.
4. Communication Systems: Analog and Digital, R.P. Singh and S.D Sapre, Tata McGraw-Hill.
5. Communication Electronics, Principles and Applications, L.E. Frenzel, Tata McGraw-Hill.
6. Electronic Communication Systems, G. Kennedy and B. Davis, Tata McGraw-Hill.

ELPP – 505 Electronics Laboratory Marks: 50

5.1	To study AM - Generator and Detector circuit
5.2	To study FM - Generator and Detector circuit
5.3	To study AM Transmitter and Receiver
5.4	To study FM Transmitter and Receiver
5.5	To study Time Division Multiplexing (TDM)
5.6	To study Pulse Amplitude Modulation (PAM)
5.7	To study Pulse Width Modulation (PWM)
5.8	To study ASK, PSK and FSK

Paper 18

PHPT-505 QUANTUM MECHANICS & ATOMIC PHYSICS

THEORY Marks: 100

Quantum Mechanics (Number of Lectures = 30)

Inadequacies of Classical physics and advent of quantum theory (black body radition). Wave particle duality; Particle properties of waves and wave properties of particles. Photoelectric effect and Compton effect. de Broglie waves. Davisson and Germer's experiment. Group and Phase velocities and relation between them. Wave Packets. Heisenberg's uncertainty principle: Derivation from wave-packets. Gamma-ray microscope experiment, Electron two-slit experiment. Wave function.

Operators in Quantum Mechanics, Conservation of probability, Normalization condition. Expectation values. Time-dependent Schroedinger wave equation. Time-independent Schroedinger equation and Stationary states. Schroedinger equation for a free particle and in the presence of a force field (one- dimension). Boundary and continuity conditions. Simple one-dimensional problems. Finite well and particle in a one-dimensional box. Tunnel effect.

Atomic Physics (Number of Lectures = 30)

Atoms in electric and magnetic fields:- Electron spin, Spin and Orbital angular momentum, Space quantization and Larmor's theorem, Stern-Gerlach experiment, Magnetic moment of the atom, Gyromagnetic ratio and Bohr Magneton.

Atoms in external magnetic fields:- Zeeman effect (Normal and Anomalous)

Many electron atoms:- Pauli's exclusion principle. Symmetric and Antisymmetric wave functions Atomic Shell Model. Periodic table.

Spin orbit coupling. Fine structure. Total angular momentum. Vector Model. L-S and J-J couplings (for 2 valence electrons only). Term symbols.

Spectra of hydrogen and alkali atoms (Na). Spectral terms. Doublet fine structure of alkali spectra. Empirical evidence of multiplets. Selection rules.

Suggested Books

1. Concepts of Modern Physics by Arthur Beiser (McGraw-Hill Book Company, 1987)
2. H. S. Mani and G. K. Mehta, Introduction to Modern Physics, Affiliated East-West Press.
3. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, 5th Edition, (Macmillan India , 2004)
4. H. E. White, Introduction to Atomic Physics.
5. Atomic physics by J.B.Rajam & foreword by Louis De Broglie.(S.Chand & Co., 2007).
6. Atomic Physics by J.H.Fewkes & John Yarwood. Vol. II (Oxford Univ. Press, 1991).
7. E. Merzbacher, Quantum Mechanics, 3rd edition, (John Wiley & Sons, Inc1997)

PHPP-505: PHYSICS LABORATORY Marks: 50

1. To determine e/m of electron by Bar Magnet or by Magnetic Focusing.
2. To determine the wavelengths of Hydrogen spectrum and hence to determine the value of Rydberg's Constant.
3. To draw the BH curve of iron by using a Solenoid and to determine the energy loss due to Hysteresis.
4. To study the PE Hysteresis loop of a Ferroelectric Crystal.
5. To determine the Hall Coefficient and the Hall angle of a Semiconductor.
6. To study the Resistivity of a Ge Crystal with temperature by Four-Probe Method and hence to determine the Band Gap E_g for it.
7. To determine the Wavelength and the Velocity of Ultrasonic Waves in a liquid (kerosene oil, xylene, etc.) by studying the Diffraction of light through an Ultrasonic Grating.
8. To determine the Specific Rotation of cane sugar using Polarimeter.
9. To analyze Elliptically Polarized Light.
10. To determine the Wavelength and the Angular Spread of a He-Ne laser.

Suggested books for references:

1. Nelson and Jon Ogborn, Practical Physics.
2. Worsnop and Flint: Advanced Practical Physics

Paper 19

MAPT-505: Real Analysis

THEORY Marks: 100

Emphasis is on visual ideas of convergence and divergence and series expansions of elementary fuctions.

Unit I : Real Sequences (30 L)

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, statement of order completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano Weierstrass' theorem. Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence.

Unit II: Infinite Series (38 L)

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test. Definition and examples of absolute and conditional convergence. Sequences and series of functions, Pointwise and uniform convergence.Mn-test, M-test, change or order of limits. Power Series: radius of convergence, Cauchy-Hadamard theorem, termby- term differentiation and integration of power series. Definition in terms of Power series and their properties of exp (x), sin (x), cos (x).

Use of computer aided software for example, Matlab/ Mathematica/ Maple/ MuPad/ wxMaxima for Taylor and Maclaurin series of sin x, cos x, log (1+*x*)*, ex,* (1+x)n*, maxima and minima, inverse of graphs.sequences*

Recommended Books

1. T. M. Apostol, Calculus, Voulme-1, *John Wiley and Sons* (Asia) Pte

Ltd., 2002.

2. R.G. Bartle and D. R Sherbert: *Introduction to real analysis,* John

Wiley and Sons (Asia) Pte. Ltd., 2000.

3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.

4. K.A. Ross, *Elementary Analysis — The Theory of Calculus Series—*

Undergraduate Texts in Mathematics, Springer Verlag, 2003.

Paper 20- Concurrent Course-I

Chemistry (cc)–I/ Comp Sc (cc) –I /Electronics (cc)-I

CHCT-501: Chemistry-1

THEORY Marks: 100

Section A: Inorganic Chemistry (30 Lectures)

Unit 1: Atomic Structure: *Recapitulation of: Bohr's theory de-Broglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure.*

Time independent Schrodinger equation ($H\Psi = E\Psi$). Significance of Ψ and Ψ^2, Schrodinger equation for hydrogen atom. Transformation of Cartesian coordinates (x,y,z) into polar coordinates ($r,\theta\phi$). Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. (Only graphical representation), Radial and angular nodes and their significance. Radial distribution functions (1s and 2s atomic orbitals). Significance of quantum numbers, orbital angular momentum and quantum numbers m_r and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Electronic configurations of the atoms. Concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit 2: Chemical Bonding and Molecular Structure

Ionic Bonding : Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Lande equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, bond moment, dipole moment and percentage ionic character.

Covalent bonding :*VB Approach* : Concept of hybridization and VSEPR theory .
Resonance and resonance energy : study of some inorganic and organic compounds.
Molecular Orbital Approach : LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals, non- bonding combination of orbitals ,MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.
Comparison of VB and MO approaches.

Section B: Physical Chemistry (30 Lectures)

Unit 3: Chemical Thermodynamics

What is thermodynamics? State of a system, state variables, intensive and extensive variables, concept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of systems and proce sses. First Law of thermodynamics. Calculation of work
(w), heat (q), changes in internal energy (ΔU) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w, q, ΔU and ΔH for processes involving changes in physical states.
Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.

Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.
Various statements of Second Law of thermodynamics, Carnot cycle, concept of entropy, Gibbs free energy a nd Helmholtz energy, Calculations of entropy change and free energy change for reversible and irreversible pr

ocesses under isothermal and adiabatic conditions. Criteria of spontaneity. Gibbs - Helmholtz equation. Maxwell's relations.
Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit 4: Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts -applications of solubility product principle. Qualitative treatment of acid base titration curves (calculation of pH at various stages of HCl – NaOH titration only). Theory of acid – base indicators.

Suggested Readings

Section A:

1. J. D. Lee : *A new Concise Inorganic Chemistry*, E L. B. S.
2. James E. Huheey, *Ellen Keiter and Richard Keiter : Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

Section B:

1 Barrow, G. M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Mahan, B. H. *University Chemistry* 3rd Ed. Narosa (1998).

CHCP-501: Chemistry Laboratory Marks: 50

Section A: Inorganic Chemistry

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$
6. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.

Section B: Physical Chemistry

(I) **Surface tension measurement** (use of organic solvents excluded)

Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

(II) **Viscosity measurement** (use of organic solvents excluded)

Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

(III) **Kinetic studies**

Study of the kinetics of the following reaction by integrated rate method: Acid hydrolysis of methyl acetate with hydrochloric acid volumetrically

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel , Prentice Hall ,7th Edition.

2. Vogel's Quantitative Chemical Analysis, A.I. Vogel , Prentice Hall ,6th Edition.
3. Senior Practical Physical Chemistry, B.D.Khosla, R. Chand & Co.

CSCT- 501: Database and Visual Basic

THEORY Marks: 100

Databases: Introduction to databases, relational database system, constraints, data manipulation, normalization, SQL.

Visual Basic: Identifiers, data types, assignment, operators and expression types, I/O statements, control structures, structure of VB program, built-in and user defined types, subroutine, functions, public, private, and static; and Dim statement. Forms and built in controls, properties and events, code module, scale modes, printer object (printing text, setting fonts, graphics), common dialog boxes, picture controls, image-controls, send keys, MS- Common controls, error handling, classes, control arrays, MDI, SDI, file handling - text files. Database Interface: Review of ANSI SQL, ODBC, DB- engine, workspaces, databases, record sets, data bound control, Active X controls, ADO, Active X Data controls, RDO, data view window, data environment designer, data report utility.

Use of Visual Basic (VB) interfacing with RDBMS, backend stored procedure usage.

CSCP-501- Database and Visual Basic. Marks: 50

PRACTICALS BASED ON CSCT-501

ELCT – 501: Electronic Circuits

THEORY Marks: 100

Diode Circuits: Diode as a circuit element, positive, negative and biased clipper circuits, clamping circuits. Power Supplies: Rectifiers– Halfwave, fullwave and bridge rectifiers- Efficiency- Ripple factor- Shunt Capacitor Filter-Regulation

Transistor Circuits: Bipolar Junction Transistor (BJT): PNP and NPN transistors–current components in BJT –BJT static characteristics (Input and Output) – Early effect- CB, CC,CE configurations (cutoff, active, and saturation regions). Biasing and load line analysis – self bias arrangement.

Small signal analysis of the CE amplifier. Qualitative study of the frequency response of CE amplifier.

Number System and Codes: Decimal, Binary, Hexadecimal, Octal, BCD, Conversions, Complements (1's and 2's), Signed and unsigned numbers, addition and subtraction, multiplication and subtraction

Logic gates and Boolean algebra

Combinational logic analysis and design: Standard representation of logic functions (SOP and POS), Minimization Techniques (k Map technique) up to 4 variable

Multiplexers and Demultiplexers, Adder (half and full) and their use as subtractor,

Sequential logic design: Latch, Flip flop, S-R FF , J-K FF, T and D type FFs, clocked FFs, registers, Counters (ripple, synchronous and asynchronous, ring, modulus)

A/D and D/A converter

Memories: Introduction to memories

Suggested Books:

1. Electronic Principles, A.P. Malvino, Tata McGraw-Hill.
2. Electronic Devices and Circuits, J.J. Cathey, Schaum's Outline Series, Tata McGraw-Hill
3. Discrete and Integrated Circuit Electronics, Donald P. Leach, Saunders College Publishing
4. Digital Systems, Principles and Applications, R.J. Tocci and N.S. Widner, Pearson Education Asia.
5. Digital Design, M.M. Mano, Pearson Education Asia.
6. Digital Fundamentals, T.L. Floyd, Pearson Education Asia.
7. Solved Problems in Digital Electronics, S.P. Bali, Sigma Series, Tata McGraw-Hill.
8. Digital Electronics, W.H. Gothmann, Prentice Hall of India.
9. Modern Digital Electronics, R.P. Jain, Tata McGraw-Hill.

ELCP – 501 Marks: 50

List of Experiments

Electronic Circuits

1.	To investigate the I-V characteristics of Silicon and Zener Diode
2.	To study a semiconductor power supply of given rating using (a) half wave and (b) full wave bridge rectifier circuits; investigate the affect of introducing C-filter; and study voltage regulation
3.	To investigate the transistor characteristics of a common-emitter circuit
4.	To investigate the transistor characteristics of a common-base circuit
5.	Verification of Logic gates (AND, OR, NOT, XOR and XNOR)
6.	To design and Study Half and Full Adder circuit
7.	To design and Study Half and Full Subtractor circuit
8.	To study RS, JK, JK MS Flip Flop
9.	To study of Multiplexer circuit and Demultiplexer circuit
10.	To study counters – ripple and decade
11.	To study D/A and A/D converter

Semester VI

Chemistry –VI/ Comp Sc –VI /Electronics-VI

Paper 21

CHPT-606: Organometallics, Bio-inorganic Chemistry, Proteins and UV-IR Spectroscopy

THEORY Marks: 100

Section A: Inorganic Chemistry-4 **(30 Lectures)**

1. **Chemistry of 3d metals**
Oxidation states displayed by Cr, Fe, Co, Ni and Co.A study of the following compounds (including preparation and important properties).
Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

2. Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, σ ,π and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. π - acceptorbehaviour of carbon monoxide. Synergic effects (VB approach). (MO diagram of CO can be referred to for synergic effect to IR frequencies).

3. **Bio-Inorganic Chemistry**
A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

Section B: Organic Chemistry-4 (30 Lectures)

1. Polynuclear and Heteronuclear aromatic compounds: Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine.

2. Amino Acids, Peptides and Proteins:
Preparation of Amino Acids: Strecker synthesis, using Gabriel's phthalimide synthesis.
Zwitter ion, Isoelectric point and Electrophoresis.
Reactions of Amino acids: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis.

3.Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions , λ_{max} & ε_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λ_{max} of conjugated dienes and α,β – unsaturated compounds.
Infrared radiations and types of molecular vibrations, functional group and Finger print region. IR spectra of alkanes, alkenes and simple alcohols (inter and intra molecular Hydrogen bonding), aldehydes , ketones, carboxylic acids and derivatives (effect of substitution on >C=O stretching absorptions) .

Suggested Readings

Section A:

1. J. D. Lee : *A new Concise Inorganic Chemistry*, E L. B. S.
2. James E. Huheey, *Ellen Keiter and Richard Keiter : Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

Section B:

1. I. L. Finar : *Organic Chemistry* (Vol. I & II), E. L. B. S.
2. R. T. Morrison & R. N. Boyd : *Organic Chemistry*, Prentice Hall.
3. Arun Bahl and B. S. Bahl : *Advanced Organic Chemistry,* S. Chand
4. Peter Sykes : *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.

CHPP-606: Chemistry Laboratory Marks: 50

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given)

Paper chromatographic separation of Fe^{3+}, Al^{3+} and Cr^{3+}

or

Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}

2. Preparation of any two of the following complexes and measurement of their conductivity:

a. tetraamminecarbonatocobalt (III) nitrate
b. tetraamminecopper (II) sulphate
c. potassium trioxalatoferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, $MgCl_2$ and $LiCl_3$.

Section B: Organic Chemistry

Systematic **Qualitative Organic Analysis** of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, 1^o amines) and preparation of one derivative.

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel , Prentice Hall ,7^{th} Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel , Prentice Hall ,6^{th} Edition.
3. Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5^{th} edition.

4. Practical Organic Chemistry, Mann F. G. & Saunders B. C, Orient Longman, 1960.

CSPT -606 : Database Management Systems
THEORY Marks: 100

Introduction to Database Management Systems : Characteristics of database approach, data models, DBMS architecture and data independence.

Entity Relationship and Enhanced ER Modeling : Entity types, relation ships, constraints, and object modeling.

Relational data model : Basic concepts, relational constraints, relational algebra, SQL queries.

Database design : ER and EER to relational mapping, functional dependencies, normal forms up to third normal form.

Books recommended:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems (5th Ed.), Pearson Education.
2. R. Ramakrishanan, J. Gehrke, Database Management Systems (3rd Ed.), McGraw-Hill.
3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts (5th Ed.), McGraw Hill.

CSPP-606- Database Management Systems Lab. Marks: 50

PRACTICALS BASED ON CSPT-606

ELPT – 606: Microprocessors

THEORY Marks: 100

Evolution of Microprocessors: Early Integrated Circuits, Idea of 4 / 8 / 16 / 32 bit Microprocessors, Recent Microprocessors

8085 Microprocessor: Architecture: CPU, description of pin out, register organization, bus system, classification of signals, timing diagram, memory mapping and I/O mapping, Classification of 8085 instructions, addressing modes, concept of assembly language, programming techniques, assembly language programming, stack and subroutines, interrupts

Interfacing Techniques and Peripherals: Basics of PIDs, handshaking signals, 8155/8156 PID, 8255 PPI, 8279 keyboard display interface, 8259 PIC, 8257 DMA

Serial and Parallel I/O

IEEE bus standards: RS-232C, RS-422, IEEE-488, S-100 Bus standards

Introduction to 8086 Microprocessor, Introduction to 8051 Microcontroller

Suggested Books:

1. Microprocessor Architecture, Programming and Applications with the 8085, R S. Gaonker, PRI-Penram International Publishing.
2. Introduction to Microcomputer and Microprocessor, B.Ram., Dhanpat Rai and Sons
3. 0000 to 8085: Introduction to Microprocessors, P.K. Sridhar and P.R. Ghosh, Prentice Hall of India.
4. /Introduction to Microprocessors, Mathur
5. D. V. HALL: Microprocessors and Interfacing
6. 8080/8085 assembly Language Programming by Intel Corporation

ELPP – 606: Electronics Laboratory Marks: 50

List of Experiments

6.1	To make a program for 8-bit addition and subtraction using µp-Kit.
6.2	To make a program for 16-bit addition and subtraction using µp-Kit.
6.3	To make a program for 8-bit multiplication using µp-Kit.
6.4	To make a program for 8-bit division using µp-Kit.
6.5	To make a program for BCD addition using µp-Kit.
6.6	To make a program for Arranging a given array in Ascending or Descending order using µp-Kit.
6.7	To make a program for Decimal to Hexadecimal/ Hexadecimal to Decimal using µp-Kit.
6.8	To make a program for Generation of Clock using µp-Kit.

6.9	Study of 8255 and 8253 μp-Kit.

Paper 22

PHPT-606 SOLID STATE & NUCLEAR PHYSICS

THEORY Marks: 100

Solid State Physics: (total Number of Lectures 30)

Solids :- Amorphous and Crystalline Materials. Lattice translation vectors. Unit Cell. Reciprocal Lattice. Crystal diffraction: Bragg's law. X-rays Diffraction of crystals.

Dielectric Properties of Matter :- Electric susceptibility, polarizability, Clausius-Mosotti equation.

Magnetic Properties of Matter :- Diamagnetic, paramagnetic, ferrimagnetic, and ferromagnetic materials. Curie's law. BH curve. Hysterisis, and energy loss.

Electrical Properties of Materials

Elementary Band Theory of Solids – Bloch theorem, Kronig- Penney model, Effective mass of electron, concept of hole. Concept of band gap and classification of solids. Energy band diagram in conductor, insulator & semiconductor. Hall effect in semiconductors (qualitative only).

Superconductivity

Experimental properties, eissener effect. Type I and II superconductors.

Nuclear & Particle Physics (Number of Lectures = 30)

Structure of nuclei: Basic properties of nuclei: (i) Mass, (ii) Size (radii), (iii) Charge, (iv) Spin (v) Parity (Ideas only), (vi) Electric and Magnetic Moments, (vii) Binding Energy. Stable and Unstable Nuclei, Magic numbers. Nuclear transformations: Radioactive decay, Half life, radioactive series. Alpha, Beta and Gamma decay. Nuclear Reactions (Direct and Compound nucleus formations), Reaction rate, Nuclear cross section. Nuclear Fission and Fusion. Nuclear Isomerism and Internal conversion.

Nuclear Forces: Meson theory of nuclear forces, simple two body nuclear force problems.

Nuclear models: Liquid Drop Model, Shell model, basic concepts of Unified model.

Particle Physics : Elementary particles, their production, properties and classification, Fundamental constituents of matter (quarks and leptons) and mediators of fundamental interactions. Elementary particle quantum numbers and idea of conservation laws in particle physics. Quarks: Color and Flavour (Ideas only).

Suggested books:

1. Concepts of nuclear physics by Bernard L.Cohen.(New Delhi: Tata Mcgraw Hill, 1998).
2. Nuclear physics by Irving Kaplan. (Oxford & IBH, 1962).
3. Introductory nuclear physics by Kenneth S. Krane.(John Wiley & Sons, 1988).
4. Atomic physics by J.B.Rajam & foreword by Louis De Broglie.(S.Chand & Co., 2007).
5. Atomic Physics by J.H.Fewkes & John Yarwood. Vol. II (Oxford Univ. Press, 1991).

6. Concepts of Modern Physics by Arthur Beiser (McGraw-Hill Book Company, 1987)
7. Introduction to solid state physics by Charles Kittel. (John Wiley & Sons, 1991).
8. Solid state physics by A J Dekker (Macmillan India Limited, 2000)

PHPP-606 PHYSICS LABORATORY Marks: 50

1. T- π network conversion.
2. To study (i) Half-wave Rectifier and (ii) Full-wave Bridge Rectifier and investigate the effect of C, L and π filters.
3. Study of diode as clipping and clamping device.
4. To design a CE Amplifier of a given gain (mid-gain) using voltage divider bias.
5. To design an Oscillator of given specifications using transistors.
6. To study Amplitude Modulation and Demodulation.
7. Study of FET characteristics.
8. Study of UJT characteristics and relaxation oscillator.

Project

1. The students should do one Project of 20 Marks.
2. The topic of the project can be from Physics, Electronics, or Computers.
3. Computer software or hardware can be used for the project.

Suggested books for references:

1. Nelson and Jon Ogborn, Practical Physics.
2. Worsnop and Flint: Advanced Practical Physics
3. Paul B. Zbar and Albert B. Malvino, Basic Electronics (A Text-Lab Manual), Tata McGraw Hill.
4. A. P. Malvino, Electronics.

Paper 23

MAPT-606: Mechanics and Discrete Mathematics

THEORY Marks: 100

Mechanics (L 30)

Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body, Laws of friction, Problems of equilibrium under forces including friction, Centre of gravity, Work and potential energy. Velocity and acceleration of a particle along a curve: radial and transverse components (plane curve), tangential and normal components (space curve), Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, Projectile Motion.

Graph Theory (L 38)

Types of graphs : Simple graph, Directed graph, Multi graph, and Pseudo graph. Graph modeling, terminology and basics. Special Graphs : Complete Graph, Cycles, n-dimensional cubes, Bipartite Graph, Complete Bipartite Graph.Subgraph and basic algebraic operations on graphs, connectivity, path, cycles, tree to be introduced as a connected graph with no cycles, introduction to shortest path (least number of edges) problem, solution of shortest path problem for simple graphs using complete enumeration. Euler and Hamiltonian graphs (for undirected graphs only) : Koenigsburg Bridge Problem, statements and interpretations of (i) necessary and sufficient conditions for Euler cycles and paths (ii) suficient condition for Hamiltonian cycles, finding Euler cycles and Hamiltonian cycles in a given graph. Tree traversal, spanning trees, weighted graphs, minimal spanning tree using Kruskal's algorithm, Prim's algorithm, Huffman codes.

Use of computer aided software for example, Matlab/ Mathematica/ Maple/ MuPad/ wxMaxima for Projectile motion, Euler and Hamiltonian graphs, Koenigsburg Bridge, , Prim's algorithm,Huffman codes.

Recommended Books

1. A.S. Ramsay, *Statics, CBS Publishers and Distributors* (Indian Reprint), 1998.
2. A.P. Roberts, *Statics and Dynamics with background in Mathematics,* Cambridge University Press, 2003.
3. K.H. Rosen, *Discrete mathematis and its applications*, McGraw-HillInternational Editions, 1999.
4.. C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis,*Pearson Education Ind. 2004.

Paper 24- Concurrent Course-II

Chemistry (cc) –II/ Comp Sc (cc)–II /Electronics (cc)-II

CHCT-602: Chemistry-2

THEORY Marks: 100

Section A: Basic Organic Chemistry (30 Lectures)

Unit 1: Fundamentals of Organic Chemistry

Concept of hybridization of carbon. Cleavage of a covalent bond: homolysis and heterolysis. Electronic effects and their applications (inductive, electromeric, hyperconjugation and resonance). Structure and stability of reactive intermediates (carbocations, carbanions and free radicals). Relative strength of carboxylic acids (aliphatic, aromatic and halo-substituted aliphatic), alcohols, phenols and nitro-phenols. Relative basic strength of amines (aliphatic and aromatic) Intermolecular and intramolecular forces: types of intermolecular forces and their characteristics (ion-dipole, dipole-dipole, dipole-induced dipole and dispersion forces). Intermolecular and intramolecular hydrogen bonding. Effect of intermolecular and intramolecular forces on properties such as solubility, vapour pressure, melting and boiling points of organic compounds.

Unit 2 : Stereochemistry

Conformations w.r.t. ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds) . Threo and erythro; D and L; *cis* - *trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Section B: Chemistry of Biomolecules (30 Lectures)

Unit 3: Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Unit 4: Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis, using Gabriel's phthalimide synthesis.
Zwitter ion, Isoelectric point and Electrophoresis.
Reactions of Amino acids: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis.

Suggested Readings

1. T. W. Graham Solomons : *Organic Chemistry, John Wiley and Sons*.
2. Arun Bahl and B. S. Bahl : *Advanced Organic Chemistry,* S. Chand.

3. E. L. Eliel : *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
4. I. L. Finar : *Organic Chemistry* (Vol. I & II), E. L. B. S.
5. R. T. Morrison & R. N. Boyd : *Organic Chemistry*, Prentice Hall.

CHCP-602: Chemistry Laboratory Marks: 50

Organic Chemistry

1. **Detection of extra elements** (N,S,Cl,Br,I) in organic compounds (containing upto two extra elements)

2. Systematic **Qualitative Organic Analysis** of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, 1^{o} amines) and preparation of one derivative.

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Suggested Readings

1. Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5^{th} edition.
2. Practical Organic Chemistry, Mann F. G. & Saunders B. C, Orient Longman, 1960.

CSCT- 602 Multimedia Systems and Applications

Multimedia Input Devices : Scanner, digital camera, microphone, video camera type setter. Multimedia Output Devices : Sound/speaker, colour monitors, printers, storage devices: CD Roms, DVD. Coding and Compression Formats for Image, Audio, Video. Nonlinear Form of Presentation : Hypertext, hypermedia, human/ computer interaction. Cognitive Aspects of Information Transfer: Various models of structuring of content methodology for developing multimedia CDROMs. Use of Multimedia tools: Sound editor, video editor, animator, authorising tools Multimedia databases, multimedia applications in education, libraries publishing, art and culture, medicine and industry.

CSCP-602- Multimedia Systems and Applications Lab. Marks: 50

PRACTICALS BASED ON CSCT-602

ELCT – 602: Communication Electronics

THEORY **Marks: 100**

Introduction : Block diagram of an electronic communication system, modulation and demodulation, electromagnetic spectrum band designations and applications. Waveform spectra and effect of filtering on complex signals.

Analog Modulation: Amplitude Modulation: Frequency spectrum of AM waves, average power, average voltage, modulation index, AM-modulator circuits (collector modulation), AM-demodulator (diode detector), single side band generation and detection.

Angle Modulation: Frequency and phase modulation, frequency spectrum of FM waves, intersystem comparisons (FM and AM), FM generation and detection

Frequency division multiplexing (FDM).

Transmitters and Receivers: Communication channels for AM and FM broadcast, AM and FM transmitter, tuned RF receiver, Superheterodyne receiver.

Pulse Analog Modulation: Sampling Theorem and Nyquist Criterion. Pulse Modulation: pulse amplitude modulation (PAM), pulse width modulation (PWM) and pulse position modulation (PPM). Time division multiplexing (TDM).

Digital Communication: Block Diagram of a PCM system, Qualitative description of noise in PCM systems, concept of ASK, FSK, PSK.

Introduction to Modern Communication Systems: Satellite Communication, Fibre Optic System, Cellular Telephone System

Suggested Books:

1. Analog and Digital Communications, H. Hsu, Schaum's Outline Series, Tata McGraw-Hill.
2. Electronic Communication, L. Temes and M. Schultz, Schaum's Outline Series, Tata McGraw-Hill.
3. Analog and Digital Communication Systems, M.J. Roden, Prentice Hall of India.
4. Communication Systems: Analog and Digital, R.P. Singh and S.D Sapre, Tata McGraw-Hill.
5. Communication Electronics, Principles and Applications, L.E. Frenzel, Tata McGraw-Hill.
6. Electronic Communication Systems, G. Kennedy and B. Davis, Tata McGraw-Hill.

ELCP – 602 Marks: 50

List of Experiments

Communication Electronics

1.	To study AM - Generator and Detector circuit
2.	To study FM - Generator and Detector circuit
3.	To study AM Transmitter and Receiver
4.	To study FM Transmitter and Receiver
5.	To study Time Division Multiplexing (TDM)
6.	To study Pulse Amplitude Modulation (PAM)
7.	To study Pulse Width Modulation (PWM)
8.	To study ASK, PSK and FSK