Details of Course: B.Sc. (Hons.) - Chemistry

Course Structure **Credits**

		Theory + Practical
I	**Core Courses (24 Papers)**	21 x 03 = 63 02 x 04 =08 01 x 02 = 02
	Core Course Practicals/ Tutorials	13 x 02 = 26 04 x 01 = 04
II	**Interdisciplinary Courses (05 Papers)**	03 x 03 = 9 02 x 04 =08
	Interdisciplinary Courses Practicals/ Tutorials	01 x 02 =02 01 x 01 = 01
III	**Ability Enhancement Courses**	
	Compulsory SS (05 Papers)	05 x 03 = 15
	Compulsory EC (01 Papers)	01 x 03 = 03
	Compulsory ES (01 Papers)	01 x 02 = 02
IV	**Project and Seminar Courses**	
	Project (01)	01 x 06 = 06
V	**SIP**	01 x 06 = 06

Total Credits = 155

Program Structure of B. Sc. (Hons.) Chemistry

Semester-I

S. No.	Code	Subject Name	L	T	P	Credits
1	BMAT 1101	Principles of Mathematics – I	3	1	-	4
2	BPHT 1101	Principles of Physics	3	-	-	3
3	BCYT 1101	Principles of Chemistry	3	-	-	3
4	BPHT 1102	Mechanics & Relativity	3	-	-	3
5	BECT 1101	English Communication	2	-	2	3
6	BCST 1101	Computer Fundamentals & Office Automation	3	-	2	4
7	BPHL 1101	Physics Practical	-	-	4	2
8	BCYL 1101	Chemistry Practical	-	-	4	2
		ALL	17	1	12	24
Total Period			30			

Semester-II

S. No.	Code	Subject Name	L	T	P	Credits
1	BMAT 1201	Principles of Mathematics-II	3	1	-	4
2	BCYT 1201	Inorganic Chemistry- I (Atomic structure & Coordination Chemistry)	3	-	-	3
3	BCYT 1202	Organic Chemistry– I (Stereochemistry and Natural Products)	3	-	-	3
4	BCYT 1203	Physical Chemistry– I (Gaseous, liquid and solid states)	3	-	-	3
5	BCYT 1204	Analytical Methods in Chemical Analysis	3	-	-	3
6	BSSS 1201	Soft Skills – I	2	-	2	3
7	BCYL 1201	Analytical Chemistry Lab			2	1
8	BCYL 1202	Inorganic Chemistry Lab- I	-	-	2	1
	BCYL 1203	Organic Chemistry Lab- I			2	1
9	BCYL 1204	Physical Chemistry Lab– I	-	-	2	1
10	BEST 1201	Environmental Studies	2	-	-	2
		ALL	21	1	10	27
		Total Period	30			

Semester-III

S. No.	Code	Subject Name	L	T	P	Credits
1	BCYT 2101	Inorganic Chemistry – II (Concepts & Models of Inorganic Chemistry)	3	-	-	3
2	BCYT 2102	Organic Chemistry – II (Compound and Derivatives)	3	-	-	3
3	BCYT 2103	Physical Chemistry – II (Thermodynamics & Equilibrium)	4	-	-	4
4	BSSS 2101	Soft Skills – II	2	-	2	3
5	BCYT 2104	Structure and Properties of Materials	4	-	-	4
6	BCYL 2101	Inorganic Chemistry Lab. – II	-	-	3	2
7	BCYL 2102	Organic Chemistry Lab.– II	-	-	3	2
8	BCYL 2103	Physical Chemistry Lab – II	-	-	3	2
9	BCYT 2105	IT Skills for Chemists	3	-	-	3
		ALL	19	-	11	26
		Total Period	30			

Semester-IV

S. No.		Subject Name	L	T	P	Credits
1	BCYT 2201	Inorganic Chemistry – III (Noble Gases and Polymers)	3	-	-	3
2	BCYT 2202	Organic Chemistry – III (Functional Group)	3	-	-	3
3	BCYT 2203	Physical Chemistry – III (Electro Chemistry)	3	-	-	3
4	BCYT 2204	Nano Science & Nano Technology	3	-	-	3
5	BCYL 2201	Inorganic Chemistry Lab.– III	-	-	4	2
6	BCYL 2202	Organic Chemistry Lab.– III	-	-	4	2
7	BCYL 2203	Physical Chemistry Lab– III	-	-	4	2
8	BCYT 2205	Green Methods in Chemistry	2	-	-	2
9	BSSS 2201	Soft Skills – III	2	-	2	3
		ALL	16	-	14	23
		Total Period	30			

Summer Internship Program – (8 weeks)

S. No.	Code	Subject Name	Credit
1	BCYP 2202	SIP: (Report, Seminar & Viva-Voce)	6

Semester-V

S. No.		Subject Name	L	T	P	Credits
1	BCYT 3101	Inorganic Chemistry – IV (Chemistry of Elements)	3	-	-	3
2	BCYT 3102	Organic Chemistry – IV (Systematic analysis of Functional Group)	3	-	-	3
3	BCYT 3103	Physical Chemistry – IV (Kinematics of Reactions)	3	-	-	3
4	BCYE 3101	Biochemistry	3*	-	-	3
5	BCYE 3102	Pharmaceutical Chemistry	3*	-	-	3
6	BCYE 3103	Environmental Chemistry	3*	-	-	3
7	BCYE 3104	Plastics and Polymers	3*	-	-	3
8	BCYL 3101	Inorganic Chemistry Lab – IV	-	-	4	2
9	BCYL 3102	Organic Chemistry Lab.– IV	-	-	4	2
10	BCYL 3103	Physical Chemistry Lab – IV	-	-	4	2
11	BSSS 3101	Soft Skills – IV	2	-	2	3
		ALL	17	-	14	30
		Total Period	31			

***Any two courses to be opted as electives.**

Semester-VI

S. No.		Subject Name	L	T	P	Credit
1	BCYT 3201	Bioinorganics and Drug Design	3*	-	-	3
2	BCYT 3202	Organic Spectroscopy and Dyes	3*	-	-	3
3	BCYE 3203	Petroleum Chemistry	3*	-	-	3
4	BCYE 3204	Advanced Materials	3*	-	-	3
5	BCYT 3203	Physical Chemistry – V (Quantum chemistry)	3	-	-	3
6	BCYT 3204	Applications of Computers in Chemistry	3	-	-	3
7	BCYL 3201	Inorganic Chemistry Lab. – V	-	-	4	2
8	BCYL 3202	Organic Chemistry Lab. – V	-	-	4	2
9	BCYL 3203	Physical Chemistry Lab – IV	-	-	4	2
10	BSSS 3201	Soft Skills – V	2	-	2	3
11	BCYP 3201	Project (Desertation)			8	8
		ALL	14	-	20	29
		Total Period	36			

***Any two courses to be opted as electives.**

Semester I

Course: Principles of Mathematics – I			**Semester: I**
Course Code: BMAT 1101	**L T P**	**3 1 0**	**Credits: 4**

Objective: To develop understanding of elementary mathematical methods and ideas among the students. This course includes numbers, operations, proportional reasoning, number theory, algebra, geometry, measurement, data analysis, and probability.

Syllabus

Matrix Algebra 19

Symmetric, skew-symmetric, Hermitian and skew-Hermitian matrices, orthogonal and unitary matrices, elementary operations on matrices, inverse of a matrix, Cramer's rule, linear dependence of rows and columns of a matrix, row rank, column rank and their equivalence, rank of a matrix, applications of matrices in solving system of linear (both homogeneous and non-homogeneous) equations, conditions of consistency for a system of linear equations.

Eigen vectors, Eigen values and the characteristics equation of a matrix, Cayley-Hamilton theorem and its use in finding inverse of a matrix, powers of matrices, orthogonal matrices, diagonalization of matrices.

Differential Calculus 19

Indeterminate forms, L' Hospital's rule. A brief review of limit, Continuity and differentiability, successive differentiation, Taylor's and Maclaurin's series expansions, tangents and normals of polar curves, derivatives of arc, asymptotes, curvature, Double points, Curve tracing.

Functions of two variables, partial differentiation and change of independent variables (two variables), Jacobians (simple applications-function of a function case), maxima and minima of two independent variables

Integral Calculus 14

Integral as limit of a sum, Fundamental theorem of integral calculus (statement only), Beta and Gamma Functions, change of order of integration in double integrals, Drichlet's theorem and its Liovelle's extension. Multiple integrals, area (quadrature), rectification (length of curves), volumes and surfaces, differentiation and integration under the integral sign

Suggested Readings

1. Thomas, G.B. & Finney, R.L. (2005). *Calculus:* 9th ed. New Delhi: Pearson Education.
2. Sharma, G. C., Ray, M. & Seth, S. S. (2010). *Differential Calculus*: 18th ed. New Delhi: Shiva Lal Agarwala & Company.
3. Dhami, H. S. (2006). *Differential Calculus.* New Delhi: New Age International.
4. Apostol, T. M. (1967). *Calculus*. New York: John Willey and Sons.
5. Prasad, G. (2004). *Differential Calculus*. Allahabad: Pothishala publication.
6. Ray, M. (2006). *Integral Calculus*. Agra: Shiva Lal Agarwal and Co.
7. Dhami, H. S. (2006). *Integral Calculus*. New Delhi: New Age International.
8. Prasad G. (2004). *Integral Calculus*. Allahabad: Pothishala Publication.
9. Strauss, M. J., Bradley, G. L. & Smith, K. J. (2007) *Calculus:* 3rd ed. Delhi: Dorling Kindersley.
10. Anton, H., Bivens, I. & Davis, S. (2002). *Calculus:* 7th ed. Singapore: John Wiley and Sons.
11. Courant, R. & John, F. (1989). *Introduction to Calculus and Analysis* (Volumes I & II). New York: Springer-Verlag.

Course: Principles of Physics			Semester: I
Course Code: BPHT 1101	**L T P**	**3 0 0**	**Credits: 3**

Objective: To introduce students to physical phenomena, physical principles and the experimental basis of the various fields of physics. This course will enable students to formulate and tackle problems in physics, including identification of appropriate physical principles and use of special and limiting cases.

Syllabus

Mathematical Physics 11

Scalar and vector products, polar and axial vectors, triple and quadruple products.

*Vector calculus***:** Scalar and vector fields, differentiation of a vector, gradient, divergence, curl and Δ operations and their meaning, idea of line, surface and volume integrals, Gauss and Stokes' theorem.

Classical Mechanics 15

Particle dynamics: Newton's laws of motion, conservation of linear momentum, center of mass, conservative forces, work energy theorem, particle collision.

Rotational kinematics and dynamics: Rotational motion, forces and pseudo forces, torque and angular momentum, kinetic energy of rotation, rigid body rotation dynamics, moment of inertia, conservation of angular momentum, comparison of linear and angular momentum, motion of a top.

Oscillations: Linearity and superposition principle, free oscillation with one and two degrees of freedom, simple pendulum, combination of two simple harmonic motions. Lissajous figures, free and damped vibrations, forced vibrations and resonance, Q factor, wave equation, travelling and standing waves, superposition of waves, phase and group velocity.

Wave optics 16

Interference, division of amplitudes, Young's double split, Fresnel's biprism, interference in thin films and wedged shaped films.

Fresnel diffraction: Diffraction at a single slit and a circular aperture, diffraction at a double split, plane transmission grating, resolving power of a telescope and a microscope, resolving and dispersive power of a plane diffraction grating.

Polarization: Polarization by reflection and refraction, Brewster's law, double refraction, Nicol prism, quarter and half-wave plates, Production and analysis of circularly and elliptically polarized light.

Suggested Readings

1. Spiegel, M. R. (1974). *Vector Analysis* Schaum's Outline Series. Singapore: McGraw-Hill Book Co.
2. Prakash S. (2014). *Mathematical physics: 6th ed.* New Delhi: Sultan Chand & Sons.
3. Rajput, B. S. (2015). *Mathematical Physics*. Meerut: Pragati Prakashan.
4. Ghatak, A. K. (2005). *Optics*. New Delhi: Tata McGraw-Hill Education.
5. Subhramanyam, N., Brijlal, M. & Avadhanulu, N. (2004). *A Text book of Optics*. New Delhi: S. Chand publication.
6. Beiser, A. (2002). *Concepts of Modern Physics.* New Delhi: McGraw-Hill Education.
7. Resnick, R., Halliday, D. & Krane, K. S. (2004). *Physics Vol. I and II* 5th ed. Hoboken: John Wiley & Sons.

Course: Principles of Chemistry			Semester: I
Course Code: BCYT 1101	**L T P**	**3 0 0**	**Credits: 3**

Objective: To enable students to understand and explain the general principles, laws, and theories of chemistry. This course will develop chemistry skills through technological advancement.

Syllabus

Structure and Bonding 4

Basic concepts of elements and compounds. Electronic structure of atoms, different types of bonding, qualitative approach to valence bond theory and its limitations. Hybridization, equivalent and non-equivalent hybrid orbitals.

Molecular Orbital Theory 4

Symmetry and overlap, molecular orbital diagrams of diatomic and simple polyatomic systems (O_2, C_2, B_3, CO, NO and their ions; HCl, BeF_2, CH_4, BCl_3) (idea of Sp3 mixing and orbital interaction to be given).

Packing in Crystals 4

Close packed structures. (1) Spinal, (2) Ilmenite and (3) Perovskite structures of mixed metal oxides, size effects, radius, ratio rules and their limitations. Lattice energy: Born equation (calculations of energy in ion pair and ion-pairs square formation), Madelung constant. Kapustinskii equation and its applications. Born-Haber cycle and its applications.

Weak Chemical Forces 4

Van-der-Waals forces, hydrogen bonding, effects of chemical forces on M.P., B.P., and solubility, energetics of dissolution process.

Oxidation-reduction Reactions 4

Oxidation number, oxidizing and reducing agents, balancing redox reactions, calculations involving redox reactions.

Stereochemistry 4

Bonding in organic molecules and its effects on shape chirality and RS nomenclature as applied to chiral centers, Treatment of chirality upto three chiral centers. Conformation of acyclic and cyclic systems, conformational analysis of Di-substituted Cyclohexanes. Geometrical isomerism and E-2 nomenclature.

Reaction Mechanism in Organic Chemistry 4

Electronic displacements in organic molecules. Aromaticity, reactivity of organic molecules. Heterolytic and hemolytic fission, Nucleophiles, Electrophiles, acids and bases and their relative strengths (including carbon acids). Addition, elimination and substitution reactions (including electrophilic, nucleophilic and aromatic types). Arynes and Carbenes as reaction intermediates.

Functional Group Chemistry 4

Functional group. Orientation effect in aromatic substitution groups: (1) Hydroxyl group, (2) Phenol, (3) Carbonyl group, (4) Carboxylic acid group and its derivatives: Esters and Amides, (5) Cyno group, (6) Nitro group, and (7) Amino group.

Organic reactions 4

(1) Aldol condensation, (2) Cannizaro reaction, (3) Claisen condensation, (4) Darzen reaction, (5) Dickermann reaction, (6) Grignard synthesis, (7) Mannich reaction, (8) Michael reaction, and (9) Perkin reaction, etc.

Polymerization 4

Types of polymerization. Forms of polymers: (1) Condensation polymerization, (2) Ring opening polymerization, (3) Addition polymerization, and (4) Zieglar-Natta polymerization. Natural and synthetic rubbers.

Suggested Readings

1. Sindhu, P S. (2012). *Modern Chemisty*. New Delhi: S. Chand & Sons.
2. Lee, J. D. (2008). *Conscise Inorganic Chemistry: 5th ed.* Oxford: Oxford University press.
3. Finar, I. L. (2002). *Organic Chemistry*, (Vol. I & II), New Delhi: Pearson Education India.
4. Morrison, R.T. & Boyd, R.N. (1992). *Organic Chemistry*: 6th ed. New Delhi: Pearson Education India.
5. Bahl, A. & Bahl, B.S. (2010). *Advanced Organic Chemistry*. New Delhi: S. Chand.
6. Graham, S. T. W. (2015). *Organic Chemistry: 11th ed.* Hoboken: John Wiley and Sons.

Course: Mechanics & Relativity			Semester: I
Course Code: BPHT 1102	**L T P**	**3 0 0**	**Credits: 3**

Objective: To familiarize students with basic principles of various mechanical operations, construction and working of the equipments including knowledge and proof of the validity of Physical Laws and nonexistence of the hypothetical stationary aether.

Syllabus

Fundamentals of Dynamics 3

Dynamics of a system of particles, centre of mass, conservation of momentum, idea of conservation of momentum from Newton's third law, impulse, momentum of variable mass system: motion of rocket.

Work and Energy Theorem 9

Work and kinetic energy theorem, conservative and non- conservative forces, potential energy, energy diagram, stable and unstable equilibrium. Gravitational potential energy, elastic potential energy, force as gradient of potential energy, work and potential energy, work done by non-conservative forces, law of conservation of energy. Elastic and inelastic collisions between particles, Center of mass and laboratory frames.

Rotational Dynamics 6

Angular momentum of a particle and system of particles, torque, conservation of angular momentum, rotation about a fixed axis, moment of inertia, calculation of moment of inertia for rectangular, cylindrical, and spherical bodies. Kinetic energy of rotation, motion involving both translation and rotation.

Gravitation and Central Force Motion 9

Law of gravitation, inertial and gravitational mass. potential and field due to spherical shell and solid sphere. Motion of a particle under central force field, two body problem and its reduction to one body problem and its solution. The energy equation and energy diagram, Kepler's laws (ideas only), orbits of artificial satellites.

Elasticity 3

Relation between elastic constants, twisting torque on a cylinder or wire.

Fluid Motion

Kinematics of Moving Fluids 2

Poiseuille's equation for flow of a liquid through a capillary tube.

Inertial and Non- Inertial Systems 6

Reference Frames

Inertial frames and Galilean transformations, Galilean invariance and conservation laws. Non-inertial frames and fictitious forces, uniformly rotating frame. Physics laws in rotating coordinate systems, centrifugal forces: Coriolis force and its applications. Components of velocity and acceleration in cylindrical and spherical coordinate systems.

Special theory of Relativity 10

Michelson-Morley experiment and its outcome, postulates of special theory of relativity, Lorentz transformations. Simultaneity and order of events, Lorentz contraction, time

dilation, relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities, variation of mass with velocity, rest mass, massless particles, mass-energy equivalence. Bucherer's experiment, relativistic Doppler effect. Relativistic kinematics, transformation of energy and momentum, energy-momentum four vector.

Suggested Readings

1. Kleppner, D., Kolenkow, R. J. (1973). *An introduction to mechanics*. New Delhi: McGraw-Hill.
2. Kittel, C., Knight, W., Ruderman, M., Helmholz, C., Moyer, B. (2007). *Mechanics.* Berkeley physics course, v.1 New York: Tata McGraw-Hill.
3. Mathur, D. S. (2000). *Mechanics*. New Delhi: S. Chand & Company Limited.
4. Symon, Keith R. (1971) *Mechanics*: 3rd ed. Boston: Addison Wesley.
5. Sears, F. W., Zemansky, M. W. & Young, H. D. (1982). *University Physics.* New Delhi: Narosa Publishing House.

Course: English Communication			Semester: I
Course Code: BECT 1101	**L T P**	**2 0 2**	**Credits: 3**

Objective: To enable students to improve both the ability to communicate and the linguistic competence in the chosen language. A balance of receptive (reading, listening) and productive (speaking, writing) skills are developed through communicative classes and self-study.

Syllabus

Communication 12

Language and communication, differences between speech and writing, distinct features of speech, distinct features of writing.

Writing Skills 15

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.

Technical Writing 15

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. Frank, M. (1990). *Writing as thinking: a guided process approach*. Englewood Cliffs: Prentice Hall.
2. Hamp-Lyons, L., & Heasley, B. (2006). *Study writing: a course in written English for academic purposes*. Cambridge: Cambridge university press.
3. Quirk, R., Greenbaum, S., Leech, G., & Startvik, J. (1994). *A comprehensive grammar of the English language*. London: Pearson Longman.
4. Riordan, D. G., Pauley, S. E. (2004). *Technical Report Writing Today:* 8th ed., Biztantra. London: Dreamtech Press.
5. Ober, S. (2007). *Contemporary Business Communication:* 7th ed. Boston: Houghton Mifflin.

Course: Computer Fundamentals & Office Automation			Semester: I
Course Code: BCST 1101	**L T P**	**3 0 2**	**Credits: 4**

Objective: To develop skills to use office automation packages, internet, etc. essential for day-to-day office management, and e-governance.

Syllabus

Introduction to Computer 8

Definition - History & generation of computer (from first to 5th) - CD, DVD, Blue ray disc, pen drive magnetic tape & Zip disk; CPU: components of CPU - mother board, hard disk, RAM, ROM, processor, SMPS & connecting wire; graphics card, sound card, network card – modem; input, output devices: keyboard, mouse, scanner, digital camera, joystick, pen drive, monitor, printer, plotter. Floppy drive, connecting port, serial, parallel, USB port. Computer networks: data communications, types of computer networks, local area networks & wide area networks.

Windows 8

Definition of Operating system, functions of OS, types of OS: single user, multi-user, multi-task, RTOS, single-user, multi-tasking, Windows desktop, GUI: definition, standards, cursors/pointers, icons, GUI menus, GUI-share data, desktop icons and their functions: My computer, creating & editing images with microsoft paint, using the calculator, personalizing windows. Linux: Linux programming & administration, introduction to Linux, features of Linux, components of Linux, Linux process, and thread management, file management system; Linux commands and utilities: cat, tail, cmp, diff, wc, sort, mkdir, cd, rmdir, pwd, cp, more, passwd, who, whoami, mv, chmod, kill, write, wall, merge, mail, news, pipes, filters and redirection utilities; System administration: installing Linux, booting the system, maintaining user accounts, file systems and special files, backups and restoration.

Introduction to MS Word 8

MS word, working with documents, opening & saving files, editing text documents, inserting, deleting, cut, copy, paste, undo, redo, find, search, replace, formatting page & setting margins, anchoring & wrapping, setting document styles, table of contents, index, page numbering, date & time, author, etc.. Creating tables- table settings, borders, alignments, insertion, deletion, merging, splitting, sorting, and formula, drawing, inserting clip arts, pictures/files etc., tools, word completion, spell checks, mail merge, templates, creating contents for books, creating letter/faxes, creating web pages, using wizards, tracking changes, security, digital signature. Printing documents – shortcut keys.

MS Excel 8

Spread sheet & its applications, opening spreadsheet, Menus - main menu, formula editing, formatting, toolbars, using icons, using help, shortcuts, spreadsheet types. Working with spreadsheets - opening, saving files, setting margins, converting files to different formats (importing, exporting, sending files to others), spread sheet addressing - rows, columns & cells, referring cells & selecting cells, shortcut keys. Entering & deleting data: entering data, cut, copy, paste, undo, redo, filling continuous rows, columns, highlighting values, find, search & replace, inserting data, insert cells, column, rows & sheets, symbols, data from external files, frames, clipart, pictures, files etc, inserting functions, manual breaks, setting

formula, finding total in a column or row, mathematical operations (addition, subtraction, multiplication, division, exponentiation), using other formulae. Formatting spreadsheets, introduction to MS office-MS Access and Open Office-base, MS Access, introduction, planning a database, starting Access, Access screen, creating a new database, creating tables, working with forms, creating queries, finding information in databases, creating reports, types of reports, printing & print preview, importing data from other databases viz. MS excel etc.

Introduction to MS Office-MS Power Point and Open Office-Impress 8

MS power point: introduction to presentation, opening new presentation, different presentation templates, setting backgrounds, selecting presentation layouts. Creating a presentation, setting presentation style, adding text to the presentation. Formatting a presentation, adding style, colour, gradient fills, arranging objects, adding header & footer, slide background, slide layout. Adding graphics to the presentation, inserting pictures, movies, tables, etc. into presentation, drawing pictures using draw. Adding effects to the presentation: setting animation & transition effect. Printing handouts, generating standalone presentation viewer. Open office - impress, introduction, creating presentation, saving presentation files, master templates & re-usability, slide transition, making presentation cds, printing handouts, operating with MS power point files / slides.

Suggested Readings

1. Rajaraman, V. (2010). *Fundamentals of Computers:* 5th ed. New Delhi: PHI Learning.
2. Sinha, P.K., Sinha P. (1992). *Computer Fundamentals*, New Delhi: BPB Publications.
3. Basandra S. (2010). *Computer Today*, New Delhi: Galgotia Publications.
4. Das, S. (2006). *Unix Concepts and Application:* 4th ed. New York: McGraw Hill Education.
5. Sagman, S. (1999). *MS-Office 2000(For Windows)*: 1st ed. Berkeley: Peachpit Press.
6. Tennenbum, A. (2012). *Computer Networks:* 5th ed. New Delhi: Pearson.

Course: Physics Practical			Semester: I
Course Code: BPHL 1101	**L T P**	**0 0 4**	**Credits: 2**

Objective: To familiarize students with experimental apparatus, the scientific method, and methods of data analysis relating to inductive process.

Syllabus

Errors in Measurements 4

Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error.

List of Practicals

A: General 24

1. To use a Multimeter for measuring (a) Resistances, (b) A/C and DC Voltages, (c) AC and DC Currents, (d) Capacitances, and (e) Frequencies.
2. To test a Diode and Transistor using (a) a Multimeter and (b) a CRO.
3. To measure (a) Voltage, (b) Frequency and (c) Phase Difference using a CRO.
4. To study the Characteristics of a Series RC Circuit.
5. To estimate the temperature of a torch bulb filament from resistance measurement and to verify Stefan's law.
6. To convert a given ammeter into a voltmeter and a given voltmeter into an ammeter and hence to calibrate the device and measure the internal resistance in each case.
7. To measure the resistance per unit length of the wire of a bridge and to determine an unknown resistance by Carey Fosters bridge.
8. To measure the current flowing in a circuit by measuring the drop of potential across a known resistance in the circuit using a potentiometer (by measuring the resistance of the potentiometer with a P.O. Box).

B: Mechanics 24

1. To determine the Acceleration due to Gravity and Velocity for a freely falling body, using Digital Timing Techniques.
2. Determination of moment of inertia of metallic cylinder / rectangular bar about an axis passing through its C.G. and to determine the rigidity modulus of the material of the suspension wire.
3. Determination of refractive index of a liquid by using travelling microscope.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Young's Modulus of a Wire by Optical Lever Method.
7. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
8. To determine the Elastic Constants of a Wire by Searle's method.

Note

Each Student is required to perform at least 10 Practicals by taking at least 5 Practicals from each of the above sections **A** and **B**.

Suggested Readings

1. Sanon, Geeta. (2007). *BSc Practical Physics*: 1st ed. New Delhi: R. Chand & Co.
2. Worsnop, B. L. & Flint, H. T. (1971). *Advanced Practical Physics*. New Delhi: Asia Publishing House.
3. Prakash I., Krishna, R. & Jha, A. K. (2012) *A Text Book of Practical Physics*. New Delhi: Kitab Mahal.
4. Khandelwal, D. P. (1985). *A Laboratory Manual of Physics for Undergraduate Classes*. New Delhi: Vani Publication House.
5. Arora, C. L. (1995). *B.Sc. Practical Physics*, New Delhi: S. Chand Limited.

Course: Chemistry Practical			Semester: I
Course Code: BCYL 1101	**L T P**	**0 0 4**	**Credits: 2**

Objectives: To introduce students to practical aspects of basic areas of Chemistry (organic, inorganic, analytical, physical and biological chemistry). This course will enable students to use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments.

Syllabus

List of Practicals

1. Colorimetric estimation of total iron using 1, 10-phenanthroline
2. Determination of ferrous ion in a solution using ferroin indicator
3. Determination of zinc by using potassium ferrocyanide
4. Estimation of strength of oxalic acid using potassium permanganate as intermediate solution
5. Determination of ph curve of an acid base titration and dissociation constant of weak acid.
6. Dissociation constant of weak electrolyte by conductometry.
7. Preparation of: (i) Aspirin (ii) Hippuric Acid (Benzoylglycine) and (iii) Methyl Orange or Phenolphthalein. Characterisation by mp, mmp, and TLC.
8. Two-step Preparations: (i) Nitrobenzene from Benzene, Purification of Nitrobenzene and characterization by refractive index, further nitration.
(ii) *P*-bromoacetanilide from Aniline.
9. Estimation of Glucose, Saponification Value or Iodine Value of a fat or oil.
10. The effect of Detergent on the Surface Tension of Water. (Variation of Surface Tension with Concentration to be studied).
11. Determination of the Rate Law for one of the following reactions. All solutions needed to be provided.
(i) Persulphate-iodine Reaction.
(ii) Iodination of Acetone.

Suggested Readings

1. Vogel, A.I. (1989). *Text-Book of Practical Organic Chemistry:* 5th ed. New Jersey: Prentice Hall.
2. Vogel, A.I. (2005). *Qualitative Chemical Analysis:* 6th ed. New Jersey: Prentice Hall.
3. Vogel, A.I. (2002). *Qualitative Inorganic Analysis*: 7th ed. New Jersey: Prentice Hall.
4. Mann, F.G. & Saunders, B.C. (1979). *Practical Organic Chemistry*, New Delhi: Orient Longman.

Semester II

Course: Principle of Mathematics –II			Semester: II
Course Code: BMAT 1201	L T P	3 1 0	Credits: 4

Objective: To make student able to solve differential equations using elementary techniques (separable or linear constant coefficient equations) and to introduce them to fundamental principles of complex variables and to illustrate their power on applications.

Syllabus

Ordinary Differential Equations 10

Higher order linear differential equations with constant coefficients, Cauchy's and Legendre's linear equations, Method of variation of parameters, Simultaneous first order linear equations with constant coefficients.

Vector Calculus 10

Gradient Divergence and Curl, Directional derivative, Irrotational and solenoidal vector fields, Vector integration, Green's theorem in a plane, Gauss divergence theorem and stokes' theorem (excluding proofs).

Function of Complex Variables 10

Functions of a complex variable, Analytic functions, Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs), Harmonic and orthogonal properties of analytic function, Harmonic conjugate, Construction of analytic functions, Conformal mapping : w= z+c, cz, 1/z, and bilinear transformation. Schwarz Christoffel Transformation.

Complex Integration 10

Complex integration, Statement and applications of Cauchy's integral theorem and Cauchy's integral formula, Taylor and Laurent expansions, Singular points, Residues, Residue theorem , Application of residue theorem to evaluate real integrals.

Suggested Readings:

1. N. P Bali and Manish Goyal, *A Text book of Engineering Mathematics*, Eighth Edition, Laxmi Publications Pvt Ltd.,2011.
2. B.S Grewal, *Higher Engineering Mathematics*", 41st Edition, Khanna Publications, Delhi, 2011.
3. H.K. Dass, and Er. Rajnish Verma, *Higher Engineering Mathematics*, S. Chand Private Ltd., 2011.
4. James Glyn, *Advanced Modern Engineering Mathematics*, 3rd Edition, Pearson Education, 2012.
5. O. V. Neil Peter, *Advanced Engineering Mathematics*, 7th Edition, Cengage learning, 2012.
6. B.V. Ramana, *Higher Engineering Mathematics*, McGraw Hill Publishing Company, New Delhi, 2008.

Course: Inorganic Chemistry – I			Semester: II
Course Code: BCYT 1201	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the atomic structure, periodicity of elements and the concept and application of coordination chemistry. The course covers the properties of the elements, valence bond theory, crystal field theory and the magnetism and thermodynamic aspects of crystal field splitting

Syllabus

Atomic Structure 12

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's uncertainty principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normal and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Contour boundary and probability diagrams. Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

Periodicity of Elements 10

Discussion of the following properties of the elements, with reference to periodic table.

a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
b) Atomic radii van der Waals) c) Ionic
and crystal radii.
(d) Covalent radii (octahedral and tetrahedral)
(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
(f) Electron gain enthalpy, trends of electron gain enthalpy.
(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffe's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

Coordination Chemistry 20

Werner's work, Recent studies on complex formation, Stability reactivity of complexes, Effective atomic number of transition metal complexes, Nomenclature of coordination compounds, Chelates and Isomerism, Shapes of d orbital. Valence bond theory. Crystal Field theory of Octahedral Complexes, Magnetism and Thermodynamic aspects of crystal field splitting, Tetragonal distortions of Octahedral Complexes (Jahn-Teller Distortions, Square Planar and Tetrahedral Complexes.

Suggested Readings

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E. and Mc Daniel, D.H., *Concepts & Models of Inorganic Chemistry*, Oxford, 1970
3. Atkins, P.W. & Paula, J. *Physical Chemistry*, Oxford Press, 2006.
4. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications 1962.
5. Satya Prakash, Inorganic Chemistry
6. Sharma and Puri, Inorganic Chemistry

Course: Organic Chemistry – I			Semester: II
Course Code: BCYT 1202	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the basics of organic chemistry, stereochemistry and the chemistry of aliphatic hydrocarbons. This course covers the formation of alkenes and alkynes by elimination reactions, mechanism of E1, E2, E1cb reactions.

Syllabus

Basics of Organic Chemistry 8

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Stereochemistry 5

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations..

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Chemistry of Aliphatic Hydrocarbons 5

Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free radical substitutions: Halogenation - relative reactivity and selectivity.

Carbon-Carbon pi Bonds 10

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti hydroxylation (oxidation). 1, 2- and 1, 4- addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes:

Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

Cycloalkanes and Conformational Analysis 6

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Aromatic Hydrocarbons 8

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Suggested Readings

1. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*; Wiley: London, 1994.
5. S. P. Singh, Organic Chemistry

Course: Physical Chemistry – I			Semester: II
Course Code: BCYT 1203	L T P	3 0 0	Credits: 3

Objective: To familiarize students with states of matter like gaseous state, liquid state, solid state as well as concept on ionic equilibria. The course will also enable students to understand electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water.

Syllabus

Gaseous State 6

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Behaviour of Real Gases 6

Deviations from ideal gas behaviour, compressibility factor, *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Liquid State 10

Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Solid State 10

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

Ionic Equilibria 10

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; dissociation constants of mono-, di- and tri- protic acids (exact treatment).

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. 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). Theory of acid – base indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

Suggested Readings

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 8th Ed., Oxford University Press (2006).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).

Course: Analytical Methods in Chemical Analysis			Semester: II
Course Code: BCYT 1204	L T P	3 0 0	Credits: 3

Objective: To introduce students to the qualitative and quantitative aspects of analysis, and optical methods of analysis, concepts of thermal method of analysis, classification of electroanalytical methods and separation techniques.

Syllabus

Qualitative and Quantitative Aspects of Analysis 5

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q, and T test, rejection of data, and confidence intervals.

Optical Methods of Analysis 10

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. *UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

Basic principle of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.

Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, Choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Electro Analytical Methods 7

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence point. Techniques used for the determination of pK_a values.

Separation Techniques 11

Solvent extraction: Classification and principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non aqueous media.

Chromatography: Classification and principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange.
Development of chromatograms: frontal, elution and displacement methods.
Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

Suggested Readings

1. Vogel, Arthur I: *A Test book of Quantitative Inorganic Analysis* (Rev. by GH Jeffery and others) 5th Ed. The English Language Book Society of Longman
2. Willard, Hobert H. *et. al*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.
4. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry* New Age, International Publisher, 2009.
6. SKoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. & Chalmes, R.A. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Ltd. London.
8. Ditts, R.V. *Analytical Chemistry – Methods of separation*.

Course: Analytical Methods in Chemical Analysis Lab			Semester: II
Course Code: BCYL 1201	L T P	0 0 2	Credits: 1

Objective: To enable students in performing analytical methods like chromatography, separation of mixtures, solvent extractions. It also includes determination of soil composition and estimation of calcium, magnesium, phosphate, nitrate salts in a soil.

Syllabus

Separation Techniques

1. **Chromatography:**

(a) Separation of mixtures

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

(ii) Separate and identify the monosaccharides present in the given mixture m(glucose & fructose) by paper chromatography. Report the R_f values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

2. **Solvent Extractions:**

(i) To separate a mixture of Ni^{2+} & Fe^{3+} by complexing with DMG and extracting the Ni^{2+} DMG complex in chloroform, and determine its concentration with spectrophotometry.

(ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.

3. Determine the pH of given aerated drinks fruit juices, shampoos and soaps.

4. Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.

5. **Analysis of soil:**

(i) Determination of pH of soil.

(ii) Total soluble salt

(iii) Estimation of calcium, magnesium, phosphate, nitrate

6. **Ion exchange:**

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.

(ii) Separation of metal ions from their binary mixture.

7. Determination of pK_a values of indicator using spectrophotometry.

8. Structural characterization of compounds by Infra-Red spectroscopy.

Suggested Readings

1.Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.

2. Vogel, Arthur I: *A Test book of Quantitative Inorganic Analysis* (Rev. by GH Jeffery and others) 5th Ed. The English Language Book Society of Longman

3. Willard, Hobert H. *et. al*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.

4. Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.
5. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.
6. SKoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. & Chalmes, R.A. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Ltd. London.
8. Ditts, R.V. *Analytical Chemistry – Methods of separation*.

Course: Inorganic Chemistry Lab – I			Semester: II
Course Code: BCYL 1202	L T P	0 0 2	Credits: 1

Objective: To **enable students to** determine chloride ion, dissolved oxygen in water, hardness in water and to estimate the alkalinity in a water sample. This course helps in analyzing the water sample of an unknown origin.

Syllabus

List of Experiments

1 Determination of Chloride by the argentometry

2 Determination of dissolved oxygen of water using iodometric titration

3 Estimation of carbonates and bicarbonates in water

4 Estimation of hardness of water

5 Titrimetric estimation alkalinity of water sample

6 Colorimetric estimation of chromium (VI) using 1,5 diphenyl carbazide

Suggested Readings

1. Vogel, A.I. (2005). *Qualitative Chemical Analysis:* 6th ed. New Jersey: Prentice Hall.
2. Vogel, A.I. (2002). *Qualitative Inorganic Analysis*: 7th ed. New Jersey: Prentice Hall.
3. Vogel, *Textbook of quantitative chemical analysis* (5th Edition), 2005.
4. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
5. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.

Course: Organic Chemistry Lab – I			Semester: II
Course Code: BCYL 1203	L T P	0 0 2	Credits: 1

Objective: To enable students to the process of purification of organic compounds and to determine the melting points and boiling points with the help of different techniques.

Syllabus

1. Purification of organic compounds by crystallization using the following solvents
   a. Water
   b. Alcohol
   c. Alcohol-Water
2. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
3. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
4. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100° C by distillation and capillary method)
5. Chromatography
   a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
   b. Separation of a mixture of two sugars by ascending paper chromatography
   c. Separation of a mixture of o- and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC

Suggested Readings

1. Vogel, A.I. (1989). *Text-Book of Practical Organic Chemistry:* 5th ed. New Jersey: Prentice Hall.
2. Mann, F.G. & Saunders, B.C. (1979). *Practical Organic Chemistry*, New Delhi: Orient Longman.
3. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
4. Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.

Course: Physical Chemistry Lab – I			Semester: II
Course Code: BCYL 1204	L T P	0 0 2	Credits: 1

Objective: To enable students to measure pH, surface tension and viscocity, and to study the effect of addition of solutes on the viscosity of water and the variation of viscosity of an aqueous solution with the concentration of solute.

Syllabus

(I) **pH Measurements**

a) Measurement of pH of different solutions 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.

c) pH metric titrations of

(i) strong acid and strong base

(ii) weak acid and strong base

(II) **Surface tension measurements** (use of organic solvents excluded).

a) Determine the surface tension by (i) drop number (ii) drop weight method.

b) Study the variation of surface tension of detergent solutions with concentration

(III) **Viscosity measurement using Ostwald's viscometer** (use of organic solvents excluded).

(a) Study the effect of the addition of solutes such as (i) polymer (ii) ethanol (iii) sodium chloride on the viscosity of water at room temperature.

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

Suggested Readings

1. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.

2. Viswanathan B, Raghavan P. S., *Practical Physical Chemistry,* VIVA BOOKS,2012.

3. Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.

4. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.

5. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.

Course: Environmental Studies			Semester: II
Course Code: BEST 1201	L T P	2 0 0	Credits: 2

Objective: To familiarize students with environmental issues including environmental pollution (sources, effects and control measure) and national and international concern for environment protection and disaster management.

Syllabus

Fundamentals of Environment 7

Meaning of Environment, Types and components of environment, nature and scope of the subject, Need for environment studies, Man-environment relationship, Biogeochemical cycles (carbon cycle, oxygen cycle, nitrogen cycle, phosphorus cycle, sulphur cycle).

Ecology and Ecosystem 7

Concept of ecology, population ecology, biome ecology, ecosystem ecology, pyramid of numbers, pyramid of energy, food chains and food webs in ecosystem, grazing food chain, detritus food chain, ecological interactions.

Soil, Water and Air Resources 6

Soil formation, basic properties of soil, soil erosion, wastelands, Properties of water, hydrological cycle, water resources, ground water, water table, Composition of air, structure of atmosphere.

Environmental Pollution 6

Air, water, soil – causes and effects and control measures. Specially: acid rain, ozone layer depletion, green house gas effect and global warming. Waste management: prevention and control measures of solid waste (general). Effects of air pollution on human health, flora and fauna,

National Concern for Environment 6

Important environmental protection Acts in India – soil, water, air (prevention and control of pollution) act, wild life conservation and forest act. Functions of central and state pollution control boards. Issues involved in enforcement of environmental legislation.

Energy Resources and Conservation **6**

Energy resources and their exploitation. Conventional energy sources: coal, oil, biomass and nature gas (overview) – over – utilization. Non-conventional energy sources: hydroelectric power, tidal, wind, geothermal energy, solar collectors, photovoltalc, nuclear-fission and fusion. Energy use pattern and future need projection in different parts of the world, energy conservation policies.

Natural Hazards and Disaster Management **4**

Natural and man-made disasters- types, causes, onset, impacts (viz earthquake, flood, drought, cyclone, tsunamic, volcanic, landslide, industrial accidents), Forecasting and management.

Suggested Readings

1. Agrawal K. M., Sikdar P. K. and Deb S. C., *A Textbook of environment*, Macmillan Publishers India Limited

2. Jeyalakshmi. R, *Principles of Environmental Studies*, 1st Edition, Devi Publications, Chennai, 2006.

3. Sharma. B. K. and Kaur, *Environmental Chemistry*, Goel Publishing House, Meerut, 1994

4. De.A.K., Environmental Chemistry, New Age International (p) lt. New Delhi, 1996

5. Dara S. S., A *Text Book of Environmental Chemistry and Pollution Control*, Chand & Company Ltd., New Delhi, 2004.

6. Nambiar R, *Textbook of Environmental Studies*, Scitech Publication (India) Pvt. Ltd., Second Edition.

Semester-3

Course: Inorganic Chemistry –II			Semester: III
Course Code: BCYT 2101	L T P	3 0 0	Credits: 3

Objective: To enable the students to understand different types of bondings, size effects and radius ratio rule. This course covers the study on molecular orbital theory and molecular orbital diagrams of diatomic molecules.

Syllabus

Chemical Bonding

Ionic Bond 10

General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

Covalent bond 12

Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach), and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electro negativity difference.

Metallic Bond 8

Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

Weak Chemical Forces 12

Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

Suggested Readings

1. Huheey, J.E. *Inorganic Chemistry*, Prentice Hall 1993
2. Douglas, B.E. and Mc Daniel, D.H., *Concepts & Models of Inorganic Chemistry*, Oxford 1970
3. Lee, J.D. *Concise Inorganic Chemistry*, ELBS (1991)
4. Shriver & Atkins, *Inorganic Chemistry*, Third Edition, Oxford Press 1994.
5. H.W. Porterfield, *Inorganic Chemistry,* Second Edition, Academic Press, 2005.

Course: Organic Chemistry -II			Semester: III
Course Code: BCYT 2102	L T P	3 0 0	Credits: 3

Objective: To understand nucleophilic substitution reactions and to study the preparation, properties and relative reactivity of primary, secondary and tertiary alcohols. This course covers the study on halogenated hydrocarbons, alchols, phenols, ethers and epoxide.

Syllabus

Chemistry of Halogenated Hydrocarbons 10

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs elimination.

Aryl halides: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; S_NAr, Benzyne mechanism

Relative reactivity of Alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.

Alchols, Phenols, Ethers and Epoxide 10

Alcohols: preparation, properties and relative reactivity of 1^{o}, 2^{o}, 3^{o} alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol- Pinacolone rearrangement; Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer – Tiemann and Kolbe's – Schmidt Reactions, Fries and Claisen rearrangements with mechanism; Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$

Carbonyl Compounds 10

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisan-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PGC). Addition reactions of unsaturated carbonyl compounds: Michael addition. Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Carboxylic Acids and their Derivatives 10

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric,

citric, maleic and fumaric acids, Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group - Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

Sulphur Containing Compounds 2

Preparation and reactions of thiols, thioethers and sulphonic acids.

Suggested Readings

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).

2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

3. Bahl, A. & Bahl, B.S. (2010). *Advanced Organic Chemistry*. New Delhi: S. Chand.

Course: Physical Chemistry –II			Semester: III
Course Code: BCYT 2103	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the chemical thermodynamics, systems of variable composition and chemical equilibrium. The course covers the study on first law, second law, third law and the free energy functions.

Syllabus

Chemical Thermodynamics 12

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, q, work, w, internal energy U and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Systems of Variable Composition 8

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Chemical Equilibrium 10

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p, K_C and K_X. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

Solutions and Colligative Properties 10

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions.

Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Suggested Readings:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 8th Ed., Oxford University Press (2006).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Engel, T. & Reid, P. *Thermodynamics, Statistical Thermodynamics, & Kinetics* Pearson Education, Inc: New Delhi (2007).
5. McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).

Course: Structure and Properties of Materials			Semester: III
Course Code: BCYT 2104	L T P	3 0 0	Credits: 3

Objective: The familiarize the students with the classification of materials, the structure and property relationship of materials. The study with this course shows how the property of a material reflects on its applications. The course also includes the introduction on nanomaterials, superconductors and different material characterization techniques.

Syllabus

Introduction 2

Classification of materials, advanced materials, modern materials' needs and current status of materials research.

Atomic Structure and Inter-atomic Bonding 4

Fundamental concept of atomic structure, electrons in atoms, Review of periodic table, bonding forces and energies, primary interatomic bonding, secondary interatomic bondings, atomic spectra, Schrödinger equation, electron orbitals, Aufbau principle, Pauli exclusion principle and Hund's rules.

Structures of Crystalline Solids 5

Crystal structures (crystal systems, crystallographic points, directions and planes), FCC, BCC and HCP crystal structures of metals, Density computations of metals, Atomic arrangements, linear and planar densities

Imperfections in Solids 4

Point defects, specification of composition, imperfection in ceramics, dislocations-linear defects, interfacial defects (grain boundaries, twin boundaries).

Reactions and Kinetics 4

Reaction kinetics, rate laws, Arrhenius equation, Diffusion, Fick's first and second laws, Thermodynamics and kinetics of melting nucleation and crystal growth.

Ceramic and Polymer Structures 5

Structures and properties of ceramics, polymer structures.

Materials Characterization Techniques 6

X-ray diffraction microscopy, Scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunnelling microscopy, atomic absorption spectroscopy, differential scanning calorimetry, etc.

Advanced Materials and Tools 6

Smart materials exhibiting ferroelectric, piezoelectric, optoelectric, semiconducting behavior, lasers and optical fibers, photoconductivity and superconductivity, nanomaterials and its synthesis, properties and applications, biomaterials, superalloys, shape memory alloys, superhard cutting tool materials.

Suggested Readings:

1. Balasubramaniam R, *Callister's Materials Science and Engineering*, Second edition, Wiley publication
2. Antony R. West, *Solid State Chemistry and its Applications*, Wiley Student Edition.
3. Barrett C. S. and Massalski T. B., *Structure of Metals*, McGraw Hill, New York.
4. Jason B. Benedict, *Recent Advances in Crystallography*, In Tech.
5. Cullity B. D, Elements of X-ray Diffraction, Addison-Wesley Publishing Co..
6. Flewitt P. E. J. and Wild R. K, *Physical Methods for Material Characterisation*, Institute of Physics Publishing.

Course: Inorganic Chemistry Lab – II			Semester: III
Course Code: BCYL 2101	L T P	0 0 3	Credits: 2

Objective: To estimate the content of copper, calcium, magnesium in the given material with the help of titration method and to experience preparations of some inorganic compounds.

Syllabus

(a) Iodo / Iodimetric Titrations

(i) Estimation of Cu (II) and $K_2Cr_2O_7$ using sodium thiosulphate solution iodimetrically.
(ii) Estimation of (i) arsenite and (ii) antimony in tartaremetic iodimetrically
(iii) Estimation of available chlorine in bleaching powder iodometrically.
(iv) Estimation of Ca with EDTA.
(v) Estimation of Mg with EDTA
(vi) To determine the total, permanent and temporary hardness of water by complexometric method using EDTA.

(b) Inorganic preparations

(i) Cuprous Chloride, Cu_2Cl_2
(ii) Ferrous Ammonium Sulphate
(iii) Cuprous oxide
(iv) Magnesium sulphate
(v) Sodium Thiosulphate
(vi) Sodium chloride from common salt
(vii) Tetraammine copper(II) sulphate monohydrate
(viii) Potassium dichromate
(ix) Chrome red
(x) Aluminium Potassium sulphate $KAl(SO4)_2.12H_2O$ (Potash alum)

Suggested Readings

1. Vogel, A.I. (2005). *Qualitative Chemical Analysis:* 6th ed. New Jersey: Prentice Hall.
2. Vogel, A.I. (2002). *Qualitative Inorganic Analysis*: 7th ed. New Jersey: Prentice Hall.
3. Vogel, *Textbook of quantitative chemical analysis* (5th Edition), 2005.
4. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
5. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.

Course: Organic Chemistry Lab - II			Semester: III
Course Code: BCYL 2102	L T P	0 0 3	Credits: 2

Objective: To gain experience in preparing some organic compounds like iodoform, acetanilide, benzyl, picric acid and aspirin etc.

Syllabus

Organic preparations

1. Acetanalide
2. P-Bromoacetanilide
3. Oxalic acid
4. Iodoform
5. Benzoin
6. Benzil
7. Phenyl Benzoate
8. M-Dinitrobenzene
9. Phthalimide
10. Picric acid
11. Tribromoaniline
12. P-nitroacetanilide
13. Benzoic acid
14. 2,4,6-Tribromophenol
15. Aspirin

Suggested Readings

1.Vogel, A.I. (1989). *Text-Book of Practical Organic Chemistry:* 5th ed. New Jersey: Prentice Hall.
2.Mann, F.G. & Saunders, B.C. (1979). *Practical Organic Chemistry*, New Delhi: Orient Longman.
3.Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
4.Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.

Course: Physical Chemistry Lab - II			Semester: III
Course Code: BCYL 2103	L T P	0 0 3	Credits: 2

Objective: To enable students to pursue experiments on physical chemistry in order to determine dissociation constant, reaction order and to calculate enthalpy of ionization, enthalpy of hydration etc.

Syllabus

1. To determine dissociation constant of a weak electrolyte by conductometry
2. Kinetics of iodination of acetone
3. To determine the rate constant and order of reaction of the hydrolysis of an ester (methyl acetate) catalysed by an acid.
4. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
5. Calculation of the enthalpy of ionization of ethanoic acid.
6. Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
7. Determination of enthalpy of hydration of copper sulphate.

Suggested Readings

1. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
2. Viswanathan B, Raghavan P. S., *Practical Physical Chemistry,* VIVA BOOKS,2012.
3. Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.
4. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.
5. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.

Course: IT Skills for Chemists			Semester: III
Course Code: BCYT 2105	L T P	3 0 0	Credits: 3

Objective: To familiarize students with the basic applications of computer for communication and for the search of recent achievement in the field of chemistry. To simulate the structure of materials with the property and applications.

Syllabus

Introduction for computer 8

Characteristics of Computers, Basic Applications of Computer, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Input/output Devices, Memory, Concepts of Hardware and Software, Classifications of computers, Definition of Information and data, Basic data types, Storage of data/Information as files.

Introduction of Windows 9

Using Mouse and Moving Icons on the screen, The My Computer Icon, The Recycle Bin, Status Bar, Start and Menu & Menu selection, Running an Application, Windows Explorer Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows, Control Panels, Wall paper and Screen Savers, Setting the date and Sound, Concept of menu Using Help, Using right Button of the Mouse, Creating Short cuts, Basics of Window Setup, Notepad, Window Accessories.

Elements of Word Processing 9

Word Processing Basic, An Introduction to Word Processing, Opening word Processing Package, The Menu Bar, Using the Help, Using the Icons below menu bar, Opening Documents and Closing documents, Opening Documents, Save and Save AS, Page Setup, Printing of Documents, Display/Hiding of Paragraph Marks and Inter Word Space, Text Creation and Manipulation, Paragraph and Tab Setting, Text Selection, Cut, copy and paste, Font and Size selection, Bold, Italic and Underline, Alignment of Text: Center, Left, Right and Justify, Formatting the Text, Changing font, Size and Color, Paragraph indenting, Bullets and Numbering, Use of Tab and Tab setting, Changing case.

Spread Sheet 8

Elements of Electronics Spread Sheet, Application/usage of Electronics Spread Sheet, Opening of Spread Sheet, The menu bar, Creation of cells and addressing of cells, Cell inputting, Manipulation of cells, Enter texts numbers and dates, Creation of tables, Cell Height and Widths, Copying of cells, Providing Formulas, Using basic functions / formalism a cell, Sum function, Average, Percentage, Other basic functions, Spread sheets for Small accountings, Maintaining invoices/budgets, Totaling of various transactions, Maintaining daily and monthly sales reports.

Computer Communication and Internet 8

Basic of Computer networks, LAN, WAN, Internet, Concept of Internet, Application of Internet, Service on Inter Net, WWW and web-sites, Electronic mails, Communication on Internet, WWW and Web Browsers, Web Browsing software, Internet Explorer, Netscape Communicator, Surfing

the Internet, Giving the URL address, Search, Moving Around in a web-site, Printing or saving portion of web pages, Down loading, Chatting on Internet.

Suggested Readings

1. Sinha P.K. Sinha, *Computer Fundamentals*, BPB Publications
2. Rajaraman, V. (2010). *Fundamentals of Computers:* 5th ed. New Delhi: PHI Learning.
3. Sinha, P.K., Sinha P. (1992). *Computer Fundamentals*, New Delhi: BPB Publications.
4. Basandra S. (2010). *Computer Today*, New Delhi: Galgotia Publications.
5. Das, S. (2006). *Unix Concepts and Application:* 4th ed. New York: McGraw Hill Education.
6. Sagman, S. (1999). *MS-Office 2000(For Windows)*: 1st ed. Berkeley: Peachpit Press.
7. Tennenbum, A. (2012). *Computer Networks:* 5th ed. New Delhi: Pearson.

Semester-4

Course: Inorganic Chemistry - III			Semester: IV
Course Code: BCYT 2201	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the chemistry of *s* and *p* block elements noble gases. The course also includes the types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones.

Syllabus

Chemistry of *s* and *p* Block Elements 21

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.
Theoretical principles involved in volumetric analysis, done in the lab.

Noble Gases 11

Occurrence & uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2 and XeF_4, XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).

Inorganic Polymers 10

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Suggested Readings

1. Greenwood, N.N. and Earnshaw, *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
2. Lee, J.D. *Concise Inorganic Chemistry*, ELBS (1991).
3. Canham, G.R. and Overton, T., *Descriptive Inorganic Chemistry*, Freeman & Co.2006
4. Cotton, F.A. and Wilkinson, G, *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.

Course: Organic Chemistry - III			Semester: IV
Course Code: BCYT 2202	L T P	3 0 0	Credits: 3

Objective: To familiarize students with the preparation and important reactions of nitrogen containing functional groups, heterocyclic compounds and general structural features on alkaloids.

Syllabus

Nitrogen Containing Functional Groups 10

Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1^0, 2^0 and 3^0 amines with Hinsberg reagent and nitrous acid; Diazonium Salts: Preparation and their synthetic applications.

Polynuclear Hydrocarbons 10

Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

Heterocyclic Compounds 12

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction
Derivatives of furan: Furfural and furoic acid.

Alkaloids 10

Natural occurrence, General structural features, Isolation and their physiological action
Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Suggested Readings:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Course: Physical Chemistry - III			Semester: IV
Course Code: BCYT 2201	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the concept of phases, components and degrees of freedom. This course covers the study on electrochemistry, emf calculation and establishment of cell reaction.

Syllabus

Phase Equilibria 20

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for non-reactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications.

Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions. Three component systems, water-chloroform-acetic acid system, triangular plots.

Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation.

Nernst distribution law: its derivation and applications.

Electrochemistry 22

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry.

Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb_2O_3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Suggested Readings

1.Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 8th Ed., Oxford University Press (2006).

2.Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).

3.Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).

4.Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).

Course: Nano Science and Nano Technology			Semester: IV
Course Code: BCYT 2204	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the importance of nanoscience and nanotechnology, the role of particle size in determining property and applications of nanomaterials in science and technology. This course covers the study on the synthesis of nanomaterials and its applications in devices.

Syllabus

Introduction 8

Scientific revolutions, time and length scale in structures, definition of a nanosystem, dimensionality and size dependent phenomena, surface to volume ratio, fraction of surface atoms, surface energy and surface stress, surface defects-Properties at nanoscale (optical, mechanical, electronic,and magnetic).

Different Classes Of Nanomaterials 8

Classification based on dimensionality, quantum dots, wells and wires, carbon- based nano materials (buckyballs, nanotubes, graphene), metal based nano materials (nanogold, nanosilver and metal oxides), nanocomposites, nanopolymers, nanoglasses, nano ceramics, biological nanomaterials.

Synthesis Of Nanomaterials 8

Bottom-up and, top down methods, chemical methods: sol-gel method, co-precipitation method, solvothermal synthesis, photochemical synthesis, sonochemical routes, Chemical Vapor Deposition (CVD), Metal Oxide Chemical Vapor Deposition (MOCVD), physical methods: ball milling, electrodeposition, spray pyrolysis, flame pyrolysis, DC/RF magnetron sputtering, Molecular Beam Epitaxy (MBE).

Fabrication And Characterization of Nanostructures 10

Nanofabrication: photolithography and its limitation-electron-beam lithography (EBL)- MEMS and NEMS Fabrication, Nanoimprint, Softlithography patterning, Characterization: Field Emission Scanning Electron Microscopy (FESEM), Environmental Scanning Electron Microscopy (ESEM), High Resolution Transmission Electron Microscope (HRTEM), Scanning Tunneling Microscope (STM), Surface Enhanced Raman spectroscopy (SERS), X-ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES), Rutherford Backscattering Spectroscopy (RBS).

Applications 8

Solar energy conversion and catalysis, molecular electronics and printed electronics, nanoelectronics, polymers with aspecial architecture, liquid crystalline systems, linear and nonlinear optical and electro-optical properties, applications in displays and other devices,

nanomaterials for data storage, photonics, plasmonics, chemical and biosensors, nanomedicine and nanobiotechnology, nanotoxicology challenges.

Suggested Readings

1. Ratner M. A. and Ratner D., *Nanotechnology : A gentle introduction to the next big idea*, Pearson education, Inc.
2. Pradeep T., *A Textbook of Nanoscience and Nanotechnology*, Tata McGraw Hill Education Pvt. Ltd., 2012.
3. Nalwa H.S., *Nanostructured Materials and Nanotechnology*, Academic Press, 2002.
4. Dupas C., Houdy P., Lahmani M., *Nanoscience: Nanotechnologies and Nanophysics*, Springer-Verlag Berlin Heidelberg, 2007.
5. Charles P. Poole Jr. & Frank J. Owens, *Introduction to Nanotechnology*, Wiley, India.
6. Mick Wilson, *Nanotechnology: Basic Science & Emerging Technologies*, (2002), CRC Press.

Course: Inorganic Chemistry Lab - III			Semester: IV
Course Code: BCYL 2201	L T P	0 0 4	Credits: 2

Objective: To familiarize practice on the complexometric titrations for the estimation of total hardnesss of water samples, estimation of Ca/Mg in drugs and biological samples etc.

Syllabus

(a) Complexometric Titrations

(i) Complexometric estimation of (i) Mg^{2+} (ii) Zn^{2+} using EDTA
(ii) Estimation of total hardnesss of water samples

(iii) Estimation of Ca^{2+} in solution by (substitution method) using Eriochrome black-T as indicator.
(iv) Estimation of Ca/Mg in drugs and Biological samples.

(b) Argentometry

Estimation of Cl^- (i) By Mohr's method, (ii) By Vohlard's method, (iii) By Fajan's method.

(c) Paper Chromatographic separation of Ni (II) and Co(II); Cu(II) and Cd (II)C

Suggested Readings

1. Vogel, A.I. (2005). *Qualitative Chemical Analysis:* 6th ed. New Jersey: Prentice Hall.
2. Vogel, A.I. (2002). *Qualitative Inorganic Analysis*: 7th ed. New Jersey: Prentice Hall.
3. Vogel, *Textbook of quantitative chemical analysis* (5th Edition), 2005.
4. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
5. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.

Course: Organic Chemistry Lab - III			Semester: IV
Course Code: BCYL 2202	L T P	0 0 4	Credits: 2

Objective: To facilitate practice on different organic preparations like Diels-Alder reaction between anthracene and maleic anhydride, Photochemical reduction of benzophenone to benzopinacol, benzoin condensation of benzaldehyde etc.

Syllabus

Organic Preparations

1. Diels-Alder reaction between anthracene and maleic anhydride
2. Reduction: nitrobenzene to azobenzene (TLC of the mixture), m-dinitrobenzene to m-nitroaniline
3. S-benzylisothiuranum salts of any one water soluble and one water insoluble acid: acetic acid, phenyl acetic acid, oxalic acid, benzoic acid, phthalicacid
4. Photochemical reduction of benzophenone to benzopinacol
5. Benzoin condensation of benzaldehyde (using thiamine hydrochloride)
6. Condensation of p-toluidine with benzaldehyde/salicylaldehyde/2-hydroxy-3- methoxy benzadehyde to get Schiff's base (solventless condensation)

Estimation of

1. Phenol and aniline by bromination with potassium bromate-potassium bromide method
2. Glycine by formylation method
3. Saponification value of an oil/fat

Suggested Readings

1. Vogel, A.I. (1989). *Text-Book of Practical Organic Chemistry:* 5th ed. New Jersey: Prentice Hall.
2. Mann, F.G. & Saunders, B.C. (1979). *Practical Organic Chemistry*, New Delhi: Orient Longman.
3. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
4. Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.

Course: Physical Chemistry Lab - III	Semester: IV

Course Code: BCYL 2203	L T P	0 0 4	Credits: 2

Objective: To enable students to study the equilibrium of reactions, and to perform experiments on potentiometric titrations. This course covers demonstrates on the construction of the phase diagrams.

Syllabus

(I) Perform the following potentiometric titrations (at least two):

(i) Strong acid with strong base

(ii) weak acid with strong base and

(iii) dibasic acid with strong base

(II) Potentiometric titration of Mohr's salt with potassium dichromate.

(III) Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.

(IV) Phase equilibria: Construction of the phase diagram of

(i) simple eutectic and

(ii) congruently melting systems, using cooling curves and ignition tube methods.

Suggested Readings

1. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
2. Viswanathan B, Raghavan P. S., *Practical Physical Chemistry,* VIVA BOOKS,2012.
3. Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.
4. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.
5. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.

Course: Green Methods in Chemistry			Semester: IV
Course Code: BCYT 2205	L T P	2 0 0	Credits: 2

Objective: To enable students to understand the importance of the concept of green chemistry. The course covers the emerging green technology and alternative energy sources, use of renewable resources and the investigation on industrial case studies.

Syllabus

Principles & Concept of Green Chemistry 6

Introduction, concept and principles-development of green chemistry, atom economy reactions, rearrangement reactions, addition reactions, uneconomic-sublimation and elimination, Wittig reactions, toxicity measures, need of green chemistry in our day to day life.

Measuring and Controlling Environmental Performance 6

Importance of measurement – lactic acid production, safer gasoline, introduction to life cycle assessment, four stages of Life Cycle Assessment (LCA), carbon foot printing, green process Matrics, eco labels, Integrated Pollution and Prevention and Control(IPPC), REACH (Registration, Evaluation, Authorization of Chemicals).

Emerging Green Technology and Alternative Energy Sources 6

Design for energy efficiency, photochemical reactions, advantages, challenge faced by photochemical process, microwave technology on chemistry, microwave heating, microwave assisted reactions, sono chemistry and green chemistry, electrochemical synthesis, examples of electrochemical synthesis.

Renewable Resources 6

Biomass, renewable energy, fossil fuels, energy from biomass, solar power, other forms of renewable energy, fuel cells, alternative economics, syngas economy, hydrogen economy, bio refinery chemicals from fatty acids, polymer from renewable resources, some other natural chemical resources.

Industrial Case Studies 4

Methyl methacrylate (MMA), Greening of acetic acid manufacture, vitamin C, leather manufacture, types of leather, difference between hide and skin, tanning, reverse tanning, vegetable tanning, chrome tanning, fat liquoring, dyeing, application, polyethylene, Ziegler Natta catalysis, metallocene catalysis, eco friendly pesticides, insecticides.

Suggested Readings

1. Lancaster Mike, Green Chemistry and Introductory text, II Edition
2. Anastas P.T. and Warner J.C, *Green Chemistry theory and Practice*, Oxford University press, Oxford (1988).

3. Tundoet P., *Green Chemistry*, Wiley –Blackwell, London (2007).
4. Protti D. Dondi et.al.,Green Chemistry T.E Graedel, Streamlined Life cycle Assessment, Prentice Hall, NewJersey (1998).
5. Ahluwalia V. K., *Methods and Reagents of Green Chemistry: An Introduction by Green Chemistry*.

Semester-5

Course: Inorganic Chemistry - IV			Semester: V
Course Code: BCYT 3101	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the concepts of acids and bases. Chemistry of d-block elements and lanthanoids and actinoids. chemical thermodynamics, systems of variable composition and chemical equilibrium. The course covers the study on low oxidation states as well.

Syllabus

Acids and Bases 10

Brönsted- Lowry concept of acid-base reaction, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.

Chemistry of d Block Elements 10

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series.

Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy).

Lanthanoids and Actinoids 10

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

Low Oxidation States: Complexes of p-acid Ligands 10

Metal carbonyls, Metal nitrosyls, Metal cyanides, Metal isocyanides, Molecular nitrogen complexes

Suggested Readings:

1. Purecell, K.F. and Kotz, J.C., *Inorganic Chemistry* W.B. Saunders Co. 1977.
2. Basolo, F, and Pearson, R.C., *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
3. Greenwood, N.N. & Earnshaw A., *Chemistry of the Elements*, Butterworth-Heinemann,1997.

Course: Organic Chemistry - IV			Semester: V
Course Code: BCYT 3102	L T P	3 0 0	Credits: 3

Objective: To enable students to understand about carbohydrates, nucleic acids and amino acids, peptides and proteins. The course also includes the structure and importance of pharmaceutical compounds.

Syllabus

Carbohydrates 10

Occurrence, classification and their biological importance

Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;

Disaccharides – Structure elucidation of maltose, lactose and sucrose

Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

Nucleic Acids 8

Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil nd Thymine; Structure of polynucleotides.

Amino acids, Peptides and Proteins 10

Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pK_a values, isoelectric point and electrophoresis;

Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups - Solid-phase synthesis Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenntion of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

Pharmaceutical Compounds: Structure and Importance 8

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis).

An elementary treatment of Antibiotics and detailed study of chloramphenicol,

Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine)

Terpenes 6

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α- terpineol.

Suggested Readings

1.Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2.Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3.Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4.Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry*, Fourth Edition, W. H. Freeman.
5. Berg, J. M., Tymoczko, J. L. & Stryer, L. *Biochemistry*, Sixth Edition, W. H. Freeman.

Course: Physical Chemistry - IV			Semester: V
Course Code: BCYT 3103	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the chemical thermodynamics, systems of variable composition and chemical equilibrium. The course covers the study on catalysis, petroleum and its products and oil and paints

Syllabus

Conductance 10

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules.

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

Chemical Kinetics 10

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

Surface chemistry: Physical adsorption, chemisorption, adsorption isotherms. nature of adsorbed state.

Catalysis 10

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

Petroleum 6
Composition, source, extraction, refinery, purification, products and uses

Colloids and emulsions 4
Definition, Classification, Interaction between particles, Preparation, Stabilization and its applications

Oil and paints 2
Composition, examples and uses

Suggested Readings:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry,* Oxford University Press (2006).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry*, Narosa (2004).
4.Laidler, K. J. *Chemical Kinetics* Pearson Education: New Delhi (2004).

Course: Biochemistry			Semester: V
Course Code: BCYT 3104	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the approach and application of biochemistry. It provides discussions on Composition and Metabolism of Carbohydrates , toxicological Chemistry, Nucleic acids and Lipids.

Syllabus

Composition and Metabolism of Carbohydrates: **9**

Types, structure, composition and uses, Monosaccharide's, Disaccharides, Polysaccharides, Oligosaccharides, Metabolism Pathways of glucose, Glycolysis, Gluconeogenesis, Cori's cycle, Tricarboxylic acid (TCA) cycle, Pentose phosphate pathways (Hexose monophosphate), Regulation of blood glucose level, Investigation and their interpretations

Composition and metabolism of Amino acids and proteins **9**

Types, structure, Composition and uses of Amino acids and proteins, Metabolism of Amino acids and proteins, Proteins synthesis, targeting and glycosylation, Chromatography, Electrophoresis, Sequencing, Metabolism of Nitrogen, Fixation and Assimilation, Urea Cycle, Hemes and chlorophylls, Enzymes and co-enzymes, Classification, Properties, Absorption, Storage & transportation, Normal concentration, Investigations and their interpretations

Toxicological Chemistry **9**

Introduction to toxicology and – Toxicants–Dose response relationship – Evaluation methods – LD50, LC50- Impact of toxic chemicals on Enzymes – Biochemical effects of arsenic, lead, mercury, Carbon monoxide, Nitrogen oxides, sulphur dioxide, ozone, PAN , cyanide ,pesticides and Carcinogens.

Nucleic Acids **9**

Structures of purine and pyrmidine bases Nucleosides, nucleotides, RNA, & DNA Types of RNA Structure of DNA, Watson and Crick model

Lipids **6**

Introduction, sources, Nomenclature Classification, Properties & Functions ,Fatty acids, Triacyl glycerols, Membrane lipids, Steroids, Structure of steroid nucleus, Biological role of Cholesterol, fat soluble vitamins, Biological Membranes

Suggested Readings

1. Environmental Chemistry, a global perspective. Gary W. Valoon & Stephen J. Duffy, Oxford University Press.
2. Chemistry for environmental engineering and science (5th edition). Clair N. Sawyer, Perry L. Me Carty, Gene F. Parkin, Tata Mc Grahill.
3. Environmental Chemistry 2000 (4th edition). A.K. de. New age International (P) Ltd., New Delhi, India.
4. Chemistry and the Environment 1973. Johnson, D.O., Netterville, J.T.,Wood, J.C., and James, M., W.B. Saunders Company, Philadelphia.

5. Toxic Chemicals, health and the Environment 1987. Lave, L.B and Upton, A.C, The Hopkins Press Ltd., London.
6. Green Chemistry (2006). Rashmi Sanghi, Srivastava M.M, Narosa.
7. Environmental Chemistry 2000 (7th edition). Manhan, Bo Co Raton, F.L, CRC Press.
8. Waste water treatment. Metcalf and Eddy.

Course: Pharmaceutical Chemistry			**Semester: V**
Course Code: BCYT 3105	**L T P**	**3 0 0**	**Credits: 3**

Objective: To familiarize students about drugs and pharmaceuticals, discovery and specific application of drugs and fermentation.

Syllabus

Introduction 7

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship.

Synthesis and Technical Manufacture 10

Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlorand Butachlor).

Drugs & Pharmaceuticals Drug discovery 11

Design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, antiinflamm atory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT-Zidovudine).

Fermentation 10

Fermentation Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Drug Delivery **4**

Introduction to drug delivery systems and pharmaceutical dosage forms. Different drug delivery processes. Target oriented drug delivery.

Suggested Readings

1. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK.

2. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke , David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi.
4. Cremlyn, R. Pesticides. Preparation and Modes of Action, John Wiley & Sons, New York, 1978.

Course: Environmental Chemistry			Semester: V
Course Code: BCYE 3101	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the environmental chemistry and to learn about water chemistry, soil chemistry, soil composition, and green chemistry.

Syllabus

Fundamentals of Environmental Chemistry **5**

Stoichiometry, chemical equilibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radionuclides.

Atmospheric Chemistry **7**

Structure and composition of atmosphere - Chemical reactions in the atmosphere: Ozone chemistry- CFC's – Acid Rain – Photochemical smog - Aerosols types- production and distribution- Aerosols and Radiation –- temperature inversion –- Green House gases - Global warming.

Water Chemistry **7**

Water resources, hydrological cycle, physical and chemical properties of water, complexation in natural and waste water, role of microorganisms, - Water pollutants- Types – Sources- Heavy metals – Metalloids – Organic – Inorganic – Biological and Radioactive – Types of reactions in various water bodies including marine environment – Eutrophication – Groundwater – Potable water.

Soil Chemistry & Soil Composition **7**

Organic & Inorganic – Soil, Physical and Chemical Properties – Cation exchange capacity – soil pH – Environmental Properties of soils: Leaching and erosion – reactions with acids and bases – Geochemical reactions that neutralize acidity – Biological Process that neutralize acidity – salt affected soils – Trace metals in soils.

Green Chemistry **5**

Principles – tools of Alternative feed stocks starting material alternative reagents, alternative solvents, alternative products and alternative catalysis.

Green Environmental Issues **6**

Introduction – Ecological and Carbon foot print – Carbon Credits – Carbon Sequestration – Clean Development mechanism (CDM) – Polluters Pay – Consumerism – Sustainable mining – Urban forestry – Green buildings – Green building practices – Approaches to green computing – Nanotechnology and Environment.

Chemistry Applications In Waste Water Treatment Methods **5**

Coagulation- oxidation- H_2O_2, fenton, ozontion, sonication- ion exchange- adsorption- membrane filtration.

Suggested Readings

1. Environmental Chemistry, a global perspective. Gary W. Valoon & Stephen J. Duffy, Oxford University Press.
2. Chemistry for environmental engineering and science (5^{th} edition). Clair N. Sawyer, Perry L. Me Carty, Gene F. Parkin, Tata Mc Grahill.
3. Environmental Chemistry 2000 (4^{th} edition). A.K. de. New age International (P) Ltd., New Delhi, India.
4. Chemistry and the Environment 1973. Johnson, D.O., Netterville, J.T.,Wood, J.C., and James, M., W.B. Saunders Company, Philadelphia.
5. Toxic Chemicals, health and the Environment 1987. Lave, L.B and Upton, A.C, The Hopkins Press Ltd., London.
6. Green Chemistry (2006). Rashmi Sanghi, Srivastava M.M, Narosa.
7. Environmental Chemistry 2000 (7^{th} edition). Manhan, Bo Co Raton, F.L, CRC Press.
8. Waste water treatment. Metcalf and Eddy.

Course: Plastics and Polymers			Semester: V
Course Code: BCYE 3102	L T P	3 0 0	Credits: 3

Objective: To familiarize the students about the application of plastics and polymers.

Syllabus

Plastics **8**

Introduction, Properties and Uses of some important plastics, Ethenoid plastics and resins, Polymerisation, Condensation polymerisation, Addition polymerization, Co-polymerisation, Ionic copolymerization, Effect of Polymer structure and properties, Molecular weight, Strength, Plastic deformation, Physical state of polymer, Elastic property, Chemical resistance, Solubility.

Production of Polymers **9**

Polythene, Polypropylene, Polystyrene, Polybutylene, Polyisobutylenem Polyacrylic acid, Polycarbonates, Vinyl resins and plastics, Polyvinyl alcohol, Polyvinyl chloride, Polyvinyl carbonate, Polyvinyl fluoride, PMMA, PTFE, Bakelite, Nylon 66.

Natural Polymers **9**

Natural resins, Polysaccharides, Starch, Glycogen, Cellulose, Proteins, Preparation of cellulose, Sulphide method of making wood cellulose, Sulphate method of producing cellulose, Recovery of by products, Processing of cellulose, Nature of Proteins, Structure of Proteins, Analysis of Proteins, Conformation of protein molecules, Denaturation of proteins.

Polymer Degradation **8**

Types of degradation, Formal degradation, Mechanical degradation, Photo degradation, Degradation by high energy radiation, Degradation by Ultra sonic waves, Oxidative degradation, Oxidation of phenol formaldehyde, anti oxidants.

Polymer Processing **9**

Compounding, Moulding constituents of plastic, Initiators and Inhibitors, Processing techniques, Moulding of plastics into articles, Casting, Thermoforming, Foaming, Reinforcing, Spinning of fibers, Mercerisation.

Suggested Readings

1. Industrial Chemistry, B K Sharma, Goel Publishing House.
2. Chemistry for environmental engineering and science (5th edition). Clair N. Sawyer, Perry L. Me Carty, Gene F. Parkin, Tata Mc Grahill.
3.Chemistry and the Environment 1973. Johnson, D.O., Netterville, J.T.,Wood, J.C., and James, M., W.B. Saunders Company, Philadelphia.
4. Toxic Chemicals, health and the Environment 1987. Lave, L.B and Upton, A.C, The Hopkins Press Ltd., London.
5. Green Chemistry (2006). Rashmi Sanghi, Srivastava M.M, Narosa.

Course: Inorganic Chemistry Lab - IV			Semester: V
Course Code: BCYL 3101	L T P	0 0 4	Credits: 2

Objective: To enable students to perform experiments on quantitative estimations of Ni^{2+}, Cu^{2+} and Al^{3+}. It is focussed on the estimation of copper, calcium, magnesium with the help of titration method and includes the inorganic preparations.

Syllabus

(a) Quantitative Analysis: The following quantitative estimations are to be carried out.
(i) Estimation of nickel (II) using Dimethylglyoxime as the precipitant.
(ii) Estimation of copper as CuSCN
(iii) Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$ through (i) Heterogeneous and (ii) Homogeneous media.
(iv) Estimation of Al (III) by precipitating with oxine and weighing as Al(oxine) 3(aluminium oxinate).

(b)Inorganic Preparations
(i)Tetraammine copper (II) sulphate, $[Cu(NH_3)4]SO_4\ H_2O$

(ii)Potassium trisoxalatochromate (III), $K_3[Cr(C_2O_4)_3]$

(iii) Cis and trans $K[Cr(C2O4)_2\ (H_2O_2]$ Potassium dioxalatodiaquachromate(III)

(iv) Pentaammine carbonato Cobalt (III) ion

(c) Spectrophotometric estimation of Ferrous ions by using 1,10 phenanthroline

Suggested Readings

1. Vogel, A.I. (2005). *Qualitative Chemical Analysis:* 6th ed. New Jersey: Prentice Hall.
2. Vogel, A.I. (2002). *Qualitative Inorganic Analysis*: 7th ed. New Jersey: Prentice Hall.
3. Vogel, *Textbook of quantitative chemical analysis* (5th Edition), 2005.
4. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
5. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.

Course: Organic Chemistry Lab - IV			Semester: V
Course Code: BCYL 3102	L T P	0 0 4	Credits: 2

Objective: To gain practical experience on the systematic analysis of Nitrogen, Sulphur and Halogens in the given unknown compounds including tests of organics functional groups.

Syllabus

1. Systematic analysis of Nitrogen, Sulphur and Halogens in the given unknown compounds

2. Tests for functional groups:
(a) When only carbon, hydrogen and oxygen are present

Carboxylic acids
Phenols
Alcohols
Aldehydes
Ketones
Esters
Carbohydrates

(b) When nitrogen is present

Amides
Primary amines
Secondary amines
Tertiary amines
Anilides
Nitro compounds

(c) When nitrogen and sulphur both are present

Tioureas
Amino sulphonic acid

Suggested Readings

1.Vogel, A.I. (1989). *Text-Book of Practical Organic Chemistry:* 5th ed. New Jersey: Prentice Hall.
2.Mann, F.G. & Saunders, B.C. (1979). *Practical Organic Chemistry*, New Delhi: Orient Longman.
3.Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
4.Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.

Course: Physical Chemistry Lab – IV			Semester: V
Course Code: BCYL 3103	L T P	0 0 4	Credits: 2

Objective: To perform experiments on the study of the determination solubility of benzoic acid in water and determination of ΔH, to determine the solubility product of calcium hydroxide.

Syllabus

1. Study of the solubility of benzoic acid in water and determination of ΔH.
2. To determine the solubility of an organic acid (e.g oxalic acid) in water at room temperature.
3. To determine the solubility product of calcium hydroxide using common ion effect of sodium hydroxide or any other strong alkali.
4. Indexing of given powder diffraction pattern of a cubic crystalline system.
5. The rate constant of a reaction between acetone and iodine in presence of mineral acid and a catalyst and to show that this reaction with respect to iodine is of zero order.
6. The strength of supplied HCl acid by titrating it against NaOH and conductance measurement method.

Suggested Readings

1. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
2. Viswanathan B, Raghavan P. S., *Practical Physical Chemistry,* VIVA BOOKS,2012.
3. Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.
4. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.
5. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.

Semester-6

Course: Bioinorganics and Drug Design			Semester: VI
Course Code: BCYE 3201	L T P	3 0 0	Credits: 3

Objective: To introduce students to the organometallic compounds and the preparation, properties and structure of metal carbonyls. The course also includes discussion on bioinorganic chemistry.

Syllabus

Theoretical Principles 5

Theoretical principles and chemistry involved in qualitative analysis of mixture of cations and anions including interferring and in solubles.

Organometallic Compounds 7

Definition and classification of organo metallic compounds, EAN rule.

Metal carbonyls 10

Preparation, properties, structure and bonding of mononuclear carbonyls. π-acceptor behaviour of carbon monoxide, synergic effect (MO diagram of CO) Carbonylate anions, ferrocene and its reactions.

Bioinorganic Chemistry 20

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.Iron and its application in bio-systems, Hemoglobin; Storage and transfer of iron.

Suggested Readings

1. Purcell, K.F & Kotz, J.C. *Inorganic Chemistry* W.B. Saunders Co, 1977.
2. Huheey, J.E., *Inorganic Chemistry*, Prentice Hall, 1993.
3. Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994.
4. Cotton, F.A. & Wilkinson, G, *Advanced Inorganic Chemistry*. Wiley-VCH, 1999.

Course: Organic Spectroscopy and Dyes			Semester: VI
Course Code: BCYE 3202	L T P	3 0 0	Credits: 3

Objective: To familiarize students with the principles of absorption and emission spectroscopy. The course also includes the study on classification, colour and constitution of dyes and preparation and applications of polymers.

Syllabus

Organic Spectroscopy 17

General principles Introduction to absorption and emission spectroscopy. UV Spectroscopy: Types of electronic transitions, λ_{max}, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ_{max} for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H- bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpetation of NMR spectra of simple compounds

Applications of IR, UV and NMR for identification of simple organic molecules.

Dyes 10

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing;

Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes - Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein;

Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

Polymers 15

Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index.

Polymerisation reactions - Addition and condensation - Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes;

Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene);

Fabrics – natural and synthetic (acrylic, polyamido, polyester);

Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers;
Biodegradable and conducting polymers with examples.

Suggested Readings

1. Kemp, W. *Organic Spectroscopy*, Palgrave.
2. Kalsi, P. S. *Textbook of Organic Chemistry* (1st Ed.), New Age International (P) Ltd. Pub.
3. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
5. Gowariker, V. R., Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.

Course: Petroleum Chemistry	**Semester: VI**

Course Code: BCYE 3203	L T P	3 0 0	Credits: 3

Objective: To familiarize the students about the petroleum, its products and applications.

Syllabus

Distillation of Crude Petroleum **8**

Preparation of petroleum for processing, fundamental of distillation process, methods of petroleum distillation, processing equipments, storage tank, rectification columns, condensers, pipelines, compresoors and pumps

Petroleum Products **9**

Classification of petroleum products, liquefied hydrocarbon gases and fuels, fiel oils, fuels for get engines, lubricants, products of oil paraffin processing and other petroleum products, lubricating and other oils, paraffins, ceresins, miscellaneous petroleum products, dye intermediates, Lacquers, Solvents and thinners

Purification of Petroleum Products **9**

Introduction, Absorptive and absorptive purification, Sulphuric acid purification, Alkaline purification, Hydrofining, New methods of purification, Demercaptanisation, Stabilisation.

Hydrocarbons from Petroleum **8**

Introduction, Raw materials, Saturated hydro carbons from natural gas, Uses of saturated hydrocarbons, Unsaturated hydrocarbons, Acetylene, Ethylene, Propylene, Butylene, Aromatic hydrocarbons , Toluene, Xylenes.

Petrochemicals **9**

Raw materials, Manufacture of petrochemicals, Alkylation, Dealkylation, Hydroalkylation, Amination by ammonolysis and reduction, Pyrolysis, Esterification, Halogenation, Hydrogenation, Nitration, Oxidation, Carbonylation, Polymerisation.

Suggested Readings

1. Kalsi, P. S. *Textbook of Organic Chemistry* (1st Ed.), New Age International (P) Ltd. Pub.
2. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
4. Gowariker, V. R., Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
5. Industrial Chemistry, B K Sharma, Goel Publishing House.

Course: Advanced Materials			Semester: VI
Course Code: BCYE 3204	L T P	3 0 0	Credits: 3

Objective: To familiarize the students about the applications of advanced materials

Syllabus

Semiconductors **7**

Introduction, Classification of semiconductors, Intrinsic semiconductors, Doped or impurity semiconductors, Effect of temperature on conductivity of intrinsic and impurity semiconductors, Degenerate semiconductors, Specific semiconductors.

Superconductors **7**

Introduction, Types of superconductors, Properties and Applications of superconductors, Super fluids,

Ferroelectric Materials **7**

Introduction, Examples of ferroelectric materials, Structure and properties of ferroelectric materials, Applications.

Carbon Nanotubes **7**

Introduction, Structure and properties of carbon nanotubes, Applications.

Nanocomposites **7**

Introduction, Examples, Preparation of nanocomposites, Structure and applications of nanocomposites.

Nano Robots **7**

Introduction, Current status, Different kinds of nano robots, Applications in target oriented drug delivery.

Suggested Readings

1. D. Callister, Jr. John Willam, Materials Science & Engineering: An Introduction , Wiley & Sons.
2. K.G. Budinski and M. K. Budinski, Engineering Materials: Properties and Selection, Prentice Hall of India.
3. Donald R. Askeland and Pradeep P. Phule, The Science and Engineering of Materials, Thomson book Company, 2003.
4. Industrial Chemistry, B K Sharma, Goel Publishing House.
5. William F. Smith, Principles of Materials Science and Engineering, Mc Graw- Hill.

Course: Physical Chemistry – V			Semester: VI
Course Code: BCYT 3203	L T P	3 0 0	Credits: 3

Objective: To enable students to understand the quantum chemistry and its applications. It provides discussions on the details of chemical boding with the help of valence bond and molecular orbital approaches.

Syllabus

Quantum Chemistry 25

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy.

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component.

Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution.

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression), radial distribution functions of 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals. Average and most probable distances of electron from nucleus.

Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

Molecular Spectroscopy: 17

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin,

Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

Suggested Readings:

1. Banwell, C. N. & McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
3.House, J. E. *Fundamentals of Quantum Chemistry* 2nd Ed. Elsevier: USA (2004).
4. Lowe, J. P. & Peterson, K. *Quantum Chemistry* Academic Press (2005).

Course: Applications of Computers in Chemistry			Semester: VI
Course Code: BCYT 3204	L T P	3 0 0	Credits: 3

Objective: To enable students to utilize computers for designing of structures, solving different problems in chemistry and learning of BASIC programs for numerical differentiation and integration.

Syllabus

Recapitulation of Computer Basics 10

PC hardware, operating systems, data storage and backup, networks, information technology. Basic operations using windows.

Computer Programming 22

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.

BASIC programs for numerical differentiation and integration (Trapezoidal rule, Simpson's rule), finding roots (quadratic formula, iterative, Newton-Raphson method), numerical solution of differential equations.

Conceptual Background of Molecular Modeling 10

Potential energy surfaces. Elementary ideas of molecular mechanics and practical MO methods. Molecular Model building by computers.

Suggested Readings

1. Noggle, J. H. *Physical chemistry on a Microcomputer*. Little Brown & Co. (1985).
2. Venit, S.M. *Programming in Basic: Problem solving with structure and style.* Jaico Publishing House: Delhi (1996).
3. Engel, T. & Reid, P. *Physical Chemistry* 2nd Ed. Pearson (2010). Chapter on Computational Chemistry.

Course: Inorganic Chemistry Lab - V			Semester: VI
Course Code: BCYL 3201	L T P	0 0 4	Credits: 2

Objective: To gain practical experience on the analysis of nitrogen, sulphur and hydrogen including the test of cations and anions.

Syllabus

Qualitative analysis

Identification of cations and simple anions in a mixture of salts containing not more than six ions (Three cations and three anions) interfering anions using semimicro scheme of analysis. If combination of cations or anions is given in the mixture, insoluble should be avoided. Spot tests should be carried out for final identifications wherever feasible.

Cation :

Pb^{2+}, Bi^{3+} Cu^{2+}, Cd^{2+}, As^{3+}, Sb^{3+}, Sn^{2+} or Sn^{4+}, Fe^{2+} OR Fe^{3+}, Al^{3+}, Cr^{3+}, Co^{2+}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, $NH4^{+}$, K^{+}

Anions

Carbonate ion CO_3^{2-}, hydrogencarbonate ion HCO_3^{-}, sulphate(VI)/sulfate(VI) ion SO_4^{2-}, sulphite (IV)/sulfite(IV) ion SO_s^{2-}, sulphide/sulfide ion S^{2-}, fluoride ion F^{-}, chloride ion Cl^{-}, bromide ion Br^{-}, iodide ion I^{-}, nitrate(V)/nitrate ion NO_3^{-}, nitrate(III)/nitrite ion NO_2^{-}, hydroxide ion/alkalis OH^{-} and the chromate (VI) ion CrO_4^{2-}

Suggested Readings

1. Vogel, A.I. (2005). *Qualitative Chemical Analysis:* 6th ed. New Jersey: Prentice Hall.
2. Vogel, A.I. (2002). *Qualitative Inorganic Analysis*: 7th ed. New Jersey: Prentice Hall.
3. Vogel, *Textbook of quantitative chemical analysis* (5th Edition), 2005.
4. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
5. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.

Course: Organic Chemistry Lab - V			Semester: VI
Course Code: BCYL 3202	L T P	0 0 4	Credits: 2

Objective: To enable the students to analyze organic functional groups as well as to analyze qualitatively some unknown organic compounds.

Syllabus

1. Tests for following functional groups
   -COOH, -OH, Carbohydrate, Aldehydes (-CHO), Ketones

2. Qualitative analysis of following types of unknown organic compounds
   1. Carbohydrates
   2. Primary, secondary and tertiary amines
   3. Nitro compounds
   4. Amides
   5. Aryl halides
   6. Hydrocarbons

Identification of the functional groups, C-C and C-N triple bonds, sp^3, sp^2 and sp hybridized C-H bonds by IR spectroscopy (IR spectra to be provided)

Suggested Readings

1.Vogel, A.I. (1989). *Text-Book of Practical Organic Chemistry:* 5th ed. New Jersey: Prentice Hall.
2.Mann, F.G. & Saunders, B.C. (1979). *Practical Organic Chemistry*, New Delhi: Orient Longman.
3.Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
4.Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.

Course: Physical Chemistry Lab - V			Semester: VI
Course Code: BCYL 3203	L T P	0 0 4	Credits: 2

Objective: To develop practical skills to estimate kinetics of decomposition reaction, heat of neutralization reaction, separation by chromatographic technique. It also demonstrates the preparation of sols like ferric hydroxide and aluminum hydroxide sols**.**

Syllabus

1. The kinetics of decomposition of sodium thiosulphate by a mineral acid.
2. The heat of neutralization of sodium hydroxide and hydrochloric acid.
3. The heat of solution of the given salt in water by calorimetry.
4. The partition coefficient of benzoic between water and benzene at room temperature.
5. The separation of amino acids by chromatographic technique.
6. To prepare the sols of ferric hydroxide sol
7. To prepare the sols of aluminium hydroxide sols.

Suggested Readings

1. Pandey O. P, Bajpai D. N, Giri S., *Practical Chemistry*, S. Chand & Company Ltd,2005.
2. Viswanathan B, Raghavan P. S., *Practical Physical Chemistry,* VIVA BOOKS,2012.
3. Christian, Gary D; *Analytical Chemistry*, 6th Ed. New York- John Willy, 2004.
4. Harris, Daniel C: *Exploring Chemical Analysis*, 2nd Ed. New York, W.H. Freeman, 2001.
5. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.