



**K.R. MANGALAM UNIVERSITY**  
THE COMPLETE WORLD OF EDUCATION

**SCHOOL OF BASIC AND APPLIED SCIENCES**

**Master of Science- Chemistry**

**M.Sc. Chemistry**

**Programme Code -68**

**2019-20**

**Approved in the 20th Meeting of Academic Council Held on 16**

**July 2019**



  
Registrar  
K.R. Mangalam University  
Sehna Road, Gurugram, (Haryana)



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**Held on 29 June 2018**

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## **PREAMBLE**

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The K. R. Mangalam University visualizes all its programmes in the best interest of their students and in this endeavour; it offers a new vision to all its Post-Graduate courses. The credit system to be implemented through this curriculum, would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities. The students pursuing this course would have to develop in depth understanding of various aspects of the subject. The conceptual understanding, development of experimental skills, designing and implementation of novel synthetic methods, developing the aptitude for academic and professional skills, research skills, acquiring basic concepts for structural elucidation with hyphenated techniques, understanding the fundamental biological processes and rationale towards computer assisted drug designing are among such important aspects.

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Associate Professor	Assistant Professor	Assistant Professor	Assistant Professor

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## **1. Introduction**

K.R. Mangalam University located on Sohna Road, Gurugram, is one of the fastest growing and most promising upcoming universities in India. It is a State Private University established in 2013 by an act of the legislature of the Haryana Government under Haryana Private Universities Act (Amendment) 8 of 2013. It is recognized by the UGC under Section 2f of the UGC Act, 1956. The primary aim of the University is to promote excellence in basic and professional education while upholding moral values.

KRMU offers various Undergraduate, Postgraduate and Doctoral Degree programs across different disciplines. The group of educational units in the University promote education in the areas of Engineering & Technology, Legal Studies, Basic and Applied Sciences, Management Sciences, Commerce, Journalism and Mass Communication, Hotel Management and Catering Technology, Medical and Allied Sciences, Architecture and Planning, Agriculture, Fashion Designing, Humanities and Education. All the disciplines follow a well-defined curriculum design keeping in view the guidelines of UGC/AICTE and appropriate regulatory bodies like Council of Architecture (COA), Bar Council of India (BCI), Pharmacy Council of India (PCI), National Council for Teachers Education (NCTE) etc., wherever applicable. All courses are semester and credit based.

### **K. R. Mangalam University is unique because of its**

- An enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.
- Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

### **Objectives**

- i. To impart undergraduate, post-graduate and Doctoral education in identified areas of higher education.
- ii. To undertake research programmes with industrial interface.
- iii. To integrate its growth with the global needs and expectations of the major stake holders through teaching, research, exchange & collaborative programmes with foreign, Indian Universities/Institutions and MNCs.
- iv. To act as a nodal center for transfer of technology to the industry
- v. To provide job oriented professional education to the local student community with particular focus on Haryana.

## **2. About School**

The school imparts both teaching and research through its various science disciplines viz Mathematics, Chemistry and Physics.

School of Basic and Applied Sciences imparts students disciplinary knowledge, enhances their skills and ability, motivating them to think ingeniously, helping them to act independently and take decisions accordingly in all their scientific pursuits and other endeavors. It strives to empower its students and faculty members to contribute for the development of society and Nation.

The faculty is in constant touch with various experts in the relevant fields and is willing to experiment with latest ideas in teaching and research.

### **VISION**

School of Basic and Applied Sciences intends for continuum growth as centre of advanced learning, research and innovation by disseminating analytical and scientific knowledge in the areas of basic and applied sciences by promoting interdisciplinary research and scientific acumen.

### **MISSION**

**M1:** Enable students to be scientists/ academicians /entrepreneurs by accomplishing fundamental and advanced research in diverse areas of basic and applied sciences.

**M2:** Build strong associations with academic organizations/industries for knowledge creation, advancement, and application of scientific fervor.

**M3:** Create conducive environment for lifelong learning.

**M4:** Empower students to be socially responsible and ethically strong individuals through value-based science education.

### **3. Programmes offered by the School**

School offers undergraduate B.Sc. (Hons) Programmes, postgraduate M.Sc. Programmes, and Doctoral Programmes. All these programmes are designed to impart scientific knowledge to the students and are aimed to provide theoretical as well as practical training in their respective fields.

The school offers undergraduate M.Sc. Chemistry. This department established in 2015. This course emphasized on hands on practice, innovative thought process and project-based learning.

### **4. M.Sc. Chemistry**

This programme aims to impart basic and applied knowledge in various branches in Chemistry with a view to produce good academics, researchers and professionals in the field.

**Eligibility Criteria:-** The student should have passed the B.Sc. (Hons.) / B.Sc. with Chemistry as a major subject, from a recognized University or equivalent with minimum 50% marks in aggregate.

**Course Outline:-** Amalgamation of advance subjects of Inorganic/ Organic/ Physical Chemistry.

**Career Options:-** Opportunities exist in natural product industry, chemical industry, pharmacy, education and forensics etc.

## **5. Programme Duration**

The minimum period required for the M.Sc. Programme offered by the University shall extend over a period of two Academic Years.

The maximum period for the completion of the M.Sc. Programme offered by the University shall be four years.

## **6. Class Timings**

The classes will be held from Monday to Friday from 09:10 am to 04:10 pm.

## **7. Scheme of Studies and Syllabi**

The syllabi of M.Sc. Chemistry for all years offered by the school with scheme of studies are given in the following pages.



### M.Sc. Chemistry Programme at a Glance

<b>SEMESTER</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>TOTAL</b>
<b>COURSES</b>	7	8	6	5	<b>26</b>
<b>CREDITS</b>	22	23	18	24	<b>87</b>

<b>SEMESTER I</b>						
<b>S.No.</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	BSCH707A	CHEMISTRY OF D AND F-BLOCK ELEMENTS AND BIOINORGANIC CHEMISTRY	4	0	0	4
2	BSCH703	STEREOCHEMISTRY, REACTION MECHANISMS AND INTERMEDIATES	4	0	0	4
3	BSCH705	THERMODYNAMICS AND ELECTROCHEMISTRY	4	0	0	4
4	BSMA715	MATHEMATICS	4	0	0	4
5	BSCH751	INORGANIC CHEMISTRY-I LAB	0	0	4	2
6	BSCH753	ORGANIC CHEMISTRY-I LAB	0	0	4	2
7	BSCH755	PHYSICAL CHEMISTRY-I LAB	0	0	4	2
<b>TOTAL</b>			<b>16</b>	<b>0</b>	<b>12</b>	<b>22</b>

<b>SEMESTER II</b>						
<b>S.No.</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	BSCH708	BORANES, SILICATES AND ORGANOMETALLIC COMPOUNDS	4	0	0	4
2	BSCH704	SPECTROSCOPY OF ORGANIC COMPOUNDS	4	0	0	4
3	BSCH706	QUANTUM CHEMISTRY AND CHEMICAL KINETICS	4	0	0	4
4	BSCS714	COMPUTER APPLICATIONS IN CHEMISTRY	4	0	0	4
5	<b>BSCH756</b>	INORGANIC CHEMISTRY-II LAB	0	0	4	2
6	BSCH754	ORGANIC CHEMISTRY-II LAB	0	0	4	2
7	<b>BSCH752</b>	PHYSICAL CHEMISTRY-II LAB	0	0	4	2
8	BSCS762	COMPUTER APPLICATIONS IN CHEMISTRY LAB	0	0	2	1
<b>TOTAL</b>			<b>16</b>	<b>0</b>	<b>14</b>	<b>23</b>

<b>SEMESTER III</b>						
<b>S.No.</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	BSCH807	CO-ORDINATION CHEMISTRY AND INORGANIC POLYMER CHEMISTRY	4	0	0	4
2	BSCH803	HETEROCYCLIC, PHOTOCHEMISTRY AND PERICYCLIC CHEMISTRY	4	0	0	4
3	BSCH805	POLYMERS	4	0	0	4
4	BSCH851	INORGANIC CHEMISTRY-III LAB	0	0	4	2
5	BSCH853	ORGANIC CHEMISTRY-III LAB	0	0	4	2
6	BSCH855	PHYSICAL CHEMISTRY-III LAB	0	0	4	2
<b>TOTAL</b>			<b>12</b>	<b>0</b>	<b>12</b>	<b>18</b>

<b>SEMESTER IV</b>						
<b>S.No.</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1		ELECTIVE	4	0	0	4
2		ELECTIVE	4	0	0	4
3		ELECTIVE	4	0	0	4
4		ELECTIVE	4	0	0	4
5	BSCH858	DISSERTATION	0	0	0	8
<b>TOTAL</b>			<b>16</b>	<b>0</b>	<b>0</b>	<b>24</b>

<b>ELECTIVES OF SEMESTER IV</b>						
<b>S.No.</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	BSCH802	CHEMISTRY OF MATERIALS	4	0	0	4
2	BSCH804	ADVANCED ORGANIC SYNTHESIS	4	0	0	4
3	BSCH806	BIOPHYSICAL CHEMISTRY	4	0	0	4
4	BSCH808	ANALYTICAL TECHNIQUES	4	0	0	4
5	BSCH810	MEDICINAL CHEMISTRY	4	0	0	4
6	BSCH812	NUCLEAR CHEMISTRY & PHOTOCHEMISTRY	4	0	0	4
7	BSCH814	BIO-INORGANIC AND SUPRAMOLECULAR CHEMISTRY	4	0	0	4
8	BSCH816	CHEMISTRY OF LIFE PROCESSES	4	0	0	4
9	BSCH818	NANOCHEMISTRY	4	0	0	4
10	BSCH820	GROUP THEORY & SPECTROSCOPY	4	0	0	4
11	BSCH822	NATURAL PRODUCT CHEMISTRY	4	0	0	4
12	BSCH824	SOLID STATE CHEMISTRY	4	0	0	4

## SEMESTER I

<b>BSCH707A</b>	<b>Chemistry of d and f-block elements and Bioinorganic Chemistry</b>	L	T	P	C
<b>Version 2.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Transition and inner transition elements				
<b>Co-requisites</b>	--				

### Course Objectives

1. To learn the students about the properties and compounds of transition elements
2. To learn the student's various concepts of electronic spectra and magnetic properties of transition complexes
3. To enable the students competently matters of separation and applications of lanthanides and actinides.
4. To provide students with a general overview of the many very fundamental tasks performed by inorganic elements in living organisms.

### Catalog Description

In this course students will learn and understand the general information about the transition and inner transition elements, their characteristic properties, electronic and magnetic behavior and will be able to draw the Orgel energy level diagram for d and f block elements. This course also helps them to get idea about the applications and to determine the term symbols for d and f block elements. This will also provide stereochemical information and separation methods.

### Course Content

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#### Unit I: Chemistry of transition elements

**12 Lectures**

General characteristic properties of transition elements, co-ordination chemistry of transition metal ions, stereochemistry of coordination compounds, ligand field theory, splitting of d orbitals in low symmetry environments, John- Teller effect, Interpretation of electronic spectra including charge transfer spectra, spectrochemical series, nephelauxetic series, metal clusters, sandwich compounds, metal carbonyls.

#### Unit II: Electronic Spectra and Magnetic Properties of Transition Metal Complexes:

**16 Lectures**

Types of electronic transition, selection rule of d-d transition, Spectroscopic ground states, correlation, Orgel energy level and Tanabe-Sugano diagrams for transition metal complexes ( $d^1$ - $d^9$  states), Calculation of  $Dq$ ,  $B$  and  $\beta$  parameters, Charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

**Unit III: General characteristics of Lanthanides and Actinides: 14 Lectures**

Lanthanide contraction and its consequences, Term symbols for Lanthanide ions, Factors that mitigate against the formation of lanthanide complexes, Electronic spectra and magnetic properties of lanthanide complexes, Lanthanide complexes as shift reagents, Difference between 4f and 5f orbitals, Spectral and magnetic properties, use of lanthanide compounds as shift reagents, Modern methods of separation of lanthanides and actinides.

**Unit IV: Bioinorganic Chemistry 10 Lectures**

Role of alkali and alkaline earth metal ions in biology; Na<sup>+</sup> -K<sup>+</sup> -Pump, ionophores and crown ethers. Metal site structure, function. Metal ion transport and storage: Ferritin, Transferrin, Siderophores and metallothionein. Electron Transfer: Cytochromes, Iron-Sulfur Proteins and Copper Proteins. Oxygen transport and storage: Hemoglobin, myoglobin, hemerythrin, hemocyanin. Other metal containing enzymes: Catalase, peroxidase, superoxide dismutase, alcohol dehydrogenase, carbonic anhydrase, carboxypeptidase, xanthine oxidase, nitrogenase, vitamin B12 coenzyme.

**Text Books**

1. J D Lee, Concise Inorganic Chemistry (ELBS with Chapman and Hall, London)
2. Jones , Elementary coordination Chemistry (Prentice-Hall)
3. R S Drago, Physical Methods in Inorganic Chemistry (International Edn. (1971), Affiliated East-West Press, New Delhi)
4. Williams, an Introduction to Bioinorganic Chemistry (C.C. Thomas Spring III)
5. Eichhorn, Inorganic Biochemistry: Vol I , 2 (Elsevier)

**Reference Books/Materials**

1. F A Cotton, R G Wilkinson. Advanced Inorganic chemistry(John Wiley & Sons)
2. Willam L Jooly, Modern Inorganic Chemistry(McGraw-Hill Inc.,US)
3. N. N. Greenwood and A. Earnshaw, Chemistry of elements (Pergamon)
4. John Wulff, structure and properties of materials, vol – 4, electronic properties (Wiley Eastern)
5. J Jones Chris, d- and f- Block Chemistry (Wiely Interscience & RSC)
6. Ochiai, Bioinorganic Chemistry (Allyn & Bacon Burton)
7. Ahuja, Chemical Analysis of the Environment (Plenum press)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH 703</b>	<b>STEREOCHEMISTRY, REACTION MECHANISMS AND INTERMEDIATES</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of reaction mechanism				
<b>Co-requisites</b>	--				

**Course objective:** In this course students will be exposed to

1. The concept of optical and geometrical isomerism's of different organic compounds.
2. The concept of reaction intermediates and their formation in different organic reactions

### Catalog Description

This course is a bunch of organic chemistry basics. In this course stereochemistry of organic compounds, geometrical isomerism and conformations are available. This course also have details of reaction mechanism with reaction intermediates.

### Course Content

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#### Unit I: Stereochemistry

**12 Lectures**

Definition and classification into optical and geometrical isomerism; Projection formulae: Fischer, flying wedge, sawhorse and Newman projection formulae; Notation of optical isomers: D-L notation, Cahn-Ingold-Prelog rules, R-S notations for optical isomers with one and two asymmetric carbon atoms, erythro and threo representations.

Optical isomerism: optical activity, optical and specific rotations ; Conditions for optical activity: Asymmetric centre , chirality , achiral molecules, meaning of (+) and (-), elements of symmetry; Racemisation: Methods of racemisation (by substitution and tautomerism); Resolution: Methods of resolution (mechanical, seeding, biochemical and conversion to Diastereoisomers) ; Asymmetric synthesis (partial and absolute synthesis); Optical activity in compounds not containing asymmetric carbon atoms- Biphenyls.

#### Unit II: Geometrical isomerism

**8 Lectures**

Geometrical isomerism : cis-trans, syn-anti and E-Z notations ;Geometrical isomerism in maleic and fumaric acids and unsymmetrical ketoximes; Methods of distinguishing geometrical isomers using melting point, dipole moment, dehydration and cyclisation.

Conformational analysis: Introduction of terms - conformers, configuration, dihedral angle, torsional strain; Conformational analysis of ethane and n-butane including energy diagrams ; Conformers of cyclohexane (chair, boat and skew boat forms) ; Bonds-ring flipping showing axial equatorial interconversions; Conformation of methyl cyclohexane.

**Unit III: Reaction Mechanism and Reactive Intermediates-I****6 Lectures**

A review of reaction mechanism including methods of determination. Linear free energy relationships and their applications (Hammett equation and modification)

**Carbocations:** Classical and non-classical, neighbouring group participation, ion-pairs, molecular rearrangements in acyclic, monocyclic and bicyclic systems, stability and reactivity of bridge-head carbocations.

**Carboanions:** Generation, structure and stability, ambient ions and their general reactions; HSAB principle and its applications.

**Unit IV: Reaction Mechanism and Reactive Intermediates-II****14 Lectures**

**Carbenes:** Stability, structure and spin states of carbenes; Cyclopropanation – spin dependence and stereochemistry; Carbene insertion to C-H bonds; Rearrangement to alkenes; Wolff rearrangement of acylcarbenes and its synthetic applications.

**Nitrenes:** Stability, structure and spin states of nitrenes; C-H bond insertions and aziridine formation; Rearrangement of acylnitrenes (Hoffmann, Curtius and Schmidt reactions with applications in organic synthesis).

**Free Radicals:** Stability and fate of organic free radicals; Metal-induced radical reactions; Radical cyclisation and coupling reactions; Addition to multiple bonds; Aromatic substitution by radicals; Allylic bromination by N- bromosuccinamide and decarboxylative bromination; Mechanism of radical reactions.

**Textbooks:**

1. E L Eliel, Stereochemistry of Carbon compounds (Textbook Publishers)
2. P. S. Kalsi, Stereochemistry and Mechanism through solved problems (New Age publishers)

**Reference Books:**

1. F A Carey & R J Sundberg, Advanced Organic Chemistry, Part-A and B (Plenum, US)
2. I L Finar & A L Finar, Organic Chemistry, Vol. 2 (Addison- Wesley)
3. I L Finar, Organic Chemistry, Vol. 1 (Longman)
4. J March, Advanced Organic Chemistry (John Wiley & Sons)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**  
**Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH705</b>	<b>Thermodynamics and Electrochemistry</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry (Graduation level)				
<b>Co-requisites</b>	--				

### Course Objectives

1. To have a basic understanding of thermodynamic parameters such as the internal energy, enthalpy, entropy, and Gibbs free energy.
2. To learn the Laws of Thermodynamics and apply them to determine the spontaneity of a reaction and derive.
3. To develop an analytic ability to solve problems relevant to statistical thermodynamics.
4. To understand the electrochemistry of solutions.

### Catalog Description

In this course students will be exposed to the concept and theory based on the thermodynamic properties of materials. They will also study the thermodynamic functions and the relation with electrochemistry.

### Course Content

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#### Unit I:

**8 Lectures**

Introduction, revision of basic concepts: Ideal and non-ideal solutions, Raoult's law. Duhem-Margules equation and its applications to vapor pressure curves (Binary liquid mixture). Extensive and intensive properties. Gibbs-Duhem equation and its applications to study of partial molar quantities. Henry's law. Thermodynamics of nonelectrolyte solutions. Excess and mixing thermodynamic properties. Entropy and third law of thermodynamics. Methods of determining the practical absolute entropies.

#### Unit II:

**12 Lectures**

Entropies of phase transition. Maxwell relations, thermodynamic equation of state, chemical potential, variation of chemical potential with temperature & pressure. Equilibrium constants and general conditions of equilibrium in terms of thermodynamic potentials.

**Statistical Thermodynamics:** Weights and configurations, the most probable configuration, thermodynamic probability and entropy: Boltzmann – Planck equation. Ensembles, ensemble average and time average of property. Maxwell-Boltzmann (MB) distribution law and its application to viscosity and diffusion of gases. Partition function and its significance.



**Unit III:****8 Lectures**

Rotational, translational, vibrational and electronic partition functions. Use of spectroscopic data for evaluation of various partition functions. Relationship between partition function and thermodynamic properties. Sackur tetrode equation. Calculation of equilibrium constant using Partition function.

**Unit IV:****12 Lectures**

Electrochemistry: Electrochemistry of solutions. Activity coefficients and ion-ion interactions. Physical significance of activity coefficient. Mean activity coefficient of an electrolyte and its determination. Derivation of Debye-Huckel theory of activity coefficients (both point ion size and finite ion size models)

**Text Books**

1. S Glasstone, An Introduction to Electrochemistry (Maurice Press)
2. J O M Bockris and A K N Reddy, Modern Electrochemistry Vol. I & II (Springer US)
3. H K Moudgil, Text book of Physical Chemistry (Prentice-Hall)

**Reference Books/Materials**

1. R C Srivastava, S K Saha and A K Jain, Thermodynamics A Core Course (Prentice-Hall of India)
2. L K Nash, Elements of statistical thermodynamics (Addison Wesley)
3. S Glasstone, Thermodynamics for Chemists (D Van Nostrand)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSMA715</b>	<b>MATHEMATICS</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Mathematics				
<b>Co-requisites</b>	--				

### Course Objectives

1. Provide the brief knowledge of Matrix and Determinants.
2. To understand and find the spherical representation of functions and solve vector related problems.
3. Recognize the different type of the function and find the differentiation.
4. Understand the general and special methods of integration and apply to solve different type of differential equations.

### Catalog Description

The Mathematics course introduces fundamental math concepts. The topics include matrices and determinant, vectors, differential and integral calculus and proportions. The focus is on learning the computational procedures and then applying the skills to problem solving in applications. This course will be equally beneficial to various scientific areas including, life science, chemical science, material science and environmental science.

### Course Content

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#### Unit I:

**12 Lectures**

#### **Matrices and Determinants:**

Definition of matrix, types of matrices (row, column, null, square, diagonal). Matrix algebra: addition, subtraction, and multiplication by a number, matrix multiplication. Transpose and adjoint of matrix, elementary transformation, representation and applications to solutions of linear equations. Definition of determinant, and its properties, evaluation of determinants. Application to simple chemistry problems. formulae in organic, inorganic and physical chemistry.

**Unit II: 12 Lectures****Cartesian coordinates:**

Plane polar coordinates, spherical representation of functions, the complex Plane, polar coordinates in trigonometric functions.

**Vectors:**

Representation and simple properties of vectors (addition and subtraction) vector addition by method of triangles, resolution of vectors. Scalar product of vector. Concept of normalization, orthogonality and complete set of unit vectors.

**Unit III: 12 Lectures****Differential Calculus:**

Derivative of a function, Derivatives of sum, differences, product, and quotient of functions, Derivative of polynomial, trigonometric, exponential, logarithmic, inverse trigonometric and implicit functions, Logarithmic Differentiation, Derivatives of functions in parametric forms, Differentiation by substitution. Partial derivatives, the total derivative, maxima and minima theorem, and simple examples related to chemistry.

**Unit IV: 10 Lectures****Integral calculus:**

General and special methods of integration, geometric interpretation of integral, evaluation of definite and some standard integrals related to chemistry. The significance of 'exponential' equations. Differential equations: simple differential equations, separable variables, homogeneous equations, exact equations, linear equations, and equations of first and second order. Application to simple chemistry problems.

**Textbooks:**

1. R Mortimer, Mathematics for Physical Chemistry, (Academic Press)

**Reference Books:**

1. F Daniel, Mathematics for physical chemistry (McGraw Hill)
2. DM Hirst, Chemical Mathematics (Longman)
3. G Stephemen, Mathematical Methods for Science Students (Prentice Hall)
4. P Yates, Chemical calculations – Mathematics for Chemistry (CRC Press)
5. T R Barrante, Applied Mathematics for Physical Chemistry
6. Differential Calculus by Shanti Narayan (S. Chand & Co.)
7. Integral Calculus by Shanti Narayan (S. Chand & Co.)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

**Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH751</b>	<b>Inorganic Chemistry-I Lab</b>	L	T	P	C
<b>Version 1.0</b>		0	0	4	2
<b>Pre-requisites/Exposure</b>	Basics of Inorganic Complex preparation				
<b>Co-requisites</b>	--				

### Course Objectives

1. To strengthen the students with inorganic complex preparations.
2. To expertise the students in organometallic complex preparation.

### Catalog Description

This course imparts the basic concepts of inorganic complex preparation which enable them to perform experiment by using a suitable synthetic procedure. This course helps them to get experience of working as a chemist on individual level or in a group to perform scientific experiments. The course also introduces the preparation of complex organometallic complexes.

### Course Content

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#### Preparations of Inorganic Complex Compounds:

**15 Labs**

1. Prussian Blue (Potassium Ferric Ferro cyanide)
2. Reineckes salt (Ammonium diammine tetra thio cyanato chromate (III))
3. Potassium tri oxalato ferrate (III) trihydrate.
4. trans-potassium di aqua bis(oxalato) chromate (III)
5. cis-potassium di aqua bis (oxalato) chromate (III)
6. Sodium hexa nitrito cobaltate (III)
7. tris (acetylacetonato) manganese (III)
8. Bis(acetylacetonato) complexes of Cu(II), Co(II)
9.  $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$
10.  $[\text{Ti}(\text{urea})_6]\text{I}_3$
11. Organotin complexes

#### Text Books

1. A I Vogel, A text book of Quantitative Inorganic Analysis (Prentice Hall)

**Reference Books/Materials**

1. W G Palmer, Experimental Inorganic Chemistry (Cambridge : University Press)
2. W R Schoeller and A.R. Powell, The analysis of minerals and ores of the rarer elements (Charles, Griffin and Company Limited)
3. G Pass & H Sutcliffe, Practical Inorganic Chemistry (Chapman Hill)
4. O. P. Pandey, D.N. Bajpai, S.Giri, Practical chemistry, S. Chand & Company Pvt. Ltd.

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH753</b>	<b>ORGANIC CHEMISTRY-I LAB</b>	L	T	P	C
<b>Version 1.0</b>		0	0	4	2
<b>Pre-requisites/Exposure</b>	Basics of reaction mechanism				
<b>Co-requisites</b>	--				

### Course Objectives

1. To enable the student for hands on learning by experiments.
2. To generate confidence among students to perform reactions or analysis.

### Catalog Description

This course comprise of identification of binary mixtures of organic compounds. This course also provides hands on experience of doing some specialized reactions.

### Course Content

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#### List of experiments:

1. Purification of binary mixtures by Thin Layer Chromatography (TLC) and Column chromatography (CC).
2. Single stage organic preparations involving various types of reactions
  - a) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol/ P-benzoquinone from hydroquinone
  - b) Cannizzaro reaction: 4-chlorobenzyldehyde as a substrate.
  - c) Aldol condensation: Dibenzal acetone from benzaldehyde.
  - d) Sandmeyer reaction: p- Chlorotoulene from p-toluidine/ o-chlorobenzoic acid from anthranillic acid
  - e) Preparation of cinnamic acid by perkin's reaction
  - f) Knoevenagel condensation reaction
  - g) Coumarin Synthesis
  - h) Synthesis of p-Nitroaniline and p- bromoaniline( Aromatic electrophilic substitutions)
3. Qualitative Analysis of Binary Mixtures (only two)  
(Any suitable Expt. may be added)

#### Practical Books:

1. B S Furniss, A J Hannaford, P W G Smith and A R Tatchel, Vogels Textbook of Practical Organic Chemistry (ELBS with Longman, Longman Singapore Publishers Pt. Ltd, Singapore.)
2. F G Mann and B C Saunders Dorling, Practical organic chemistry (Kindersley (India) Pvt Ltd., New Delhi)
3. H T Clarke, A Handbook of organic analysis: Qualitative and quantitative (E. Arnold and Co., London)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination  
Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH755</b>	<b>Physical Chemistry-I Lab</b>	L	T	P	C
<b>Version 1.0</b>		0	0	4	2
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

1. To learn the theory behind potentiometric titrations.
2. To calculate dissociation constant of weak acids making use of conductance values.
3. To understand the working principle behind thermochemistry experiments.
4. To determine relative strengths of acids in a given mixture.

### Catalog Description

This course imparts the basic concepts and protocols of potentiometry, conductometry, thermodynamics and refractometry. It enables students to perform several diverse types of titrations that can be done making use of potential measurements and conductance measurements. The course also includes experimental ways find out heat of several processes, like, dilution, dissolution, and fusion.

### Course Content

#### List of experiments:

1. Potentiometry: Determination of solubility and solubility product of silver halides, determination of binary mixture of weak and strong acid etc.
2. Conductometry: Determination of mixture of acids and relative strength of weak acids.
3. Conductometric titration of a weak acid with strong base.
4. Conductometric titration of a mixture of weak and strong acids
5. To determine equivalent conductance at infinite dilution of strong electrolytes and Weak acid by using Kohlrausch Law and dissociation constant for weak acid conductometrically.
6. Refractometry: Determination of molecular radius of molecule of organic compound.
7. Thermochemistry Determination of heats of dilution and integral heat of solutions.
8. Latent heat of Fusion Determination of latent heat of fusion of a given solid.
9. Determine the solubility and solubility product of an insoluble salt, AgX (X=Cl, Br ) potentiometrically.
10. Titrate potentiometrically solution of KCl/KBr/KI



### **Practical Books**

1. B Viswanathan and P S Raghavan, Practical Physical Chemistry (Viva books)
2. V D Athawale and Parul Mathur, Experimental Physical Chemistry (New Age International Pvt. Ltd.)
3. A Finlay and J A Kitchener, Practical Physical Chemistry (Longman)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**  
**Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/ Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

## SEMESTER II

<b>BSCH708</b>	<b>Boron, silicates and organometallic compounds</b>	L	T	P	C
<b>Version 2.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Chemical properties of B, Si and organometallic compounds				
<b>Co-requisites</b>	--				

### Course Objectives

1. To learn basics chemistry and properties of compounds based on B and Si
2. To learn characteristic properties and bonding in organometallic compounds
3. To study the characteristics features and applications of clay, zeolites
4. To enable the students about metallocycles and dinitrogen complexes

### Catalog Description

Various organometallic compounds are synthesized as they are used for several applications such as pesticides, food, cosmetics, essential oils, fats and oils, medicines, paints and varnishes, polymers etc. It is important to understand the structure and bonding in those compounds. In this course students will be able to learn and understand the characteristic properties, structures and bonding in boron and silicon based compounds. This course also helps them to get idea about the applications and research importance of clays and zeolites.

### Course Content

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**Unit I: Chemistry of Boron compounds: 14 Lectures**

Chemistry of inorganic rings, cages and metal cluster compounds, borazines, phosphazenes, polyhedral boranes, higher Boranes, carboranes, metalloboranes and metallocarboranes; Classification, Nomenclature, preparation, structure and bonding.

**Unit II: Silicates and aluminosilicates: 16 Lectures**

Classification, structure, properties and applications of naturally occurring silicates and aluminosilicates. Synthesis of pillared clays and zeolites.

Characterization of clays, pillared clays and zeolites from measurement of surface area, surface activity, pores size distribution and interlayer spacing.

Application of clays, pillared clays and zeolites with emphasis of catalysis.

**Unit III: Organometallics-I:****14 Lectures**

General Introduction, Structure and bonding, importance of organometallic chemistry, Survey of Organometallic complexes according to ligands.  $\pi$  bonded organometallic compounds including carbonyls, binary carbonyls, mixed metal polynuclear carbonyls; nitrosyls, tertiary phosphines, hydrides, alkene, alkyne, cyclobutadiene, cyclopentadiene, arene compounds and their M. O. diagrams.

**Unit IV: Organometallics-II:****12 Lectures**

Synthetic Applications of Organometallic Reagents, Reagents and Applications of Organotransition element reagents (viz. Pd-coupling reactions, Pauson Khand, Rh-cyclopropanation, olefin metathesis, Tebbe's, Ziegler-Natta, McMurry, Wilkinson, Schrock, other reductions, etc.), Organo-Sn, Organo-Ti, Grignard, Organo-Pb, etc., Carbenes. Applications of organometallics in organic synthesis; C-C bond coupling, reactions (Heck, sangoshira, Suzuki); Reduction using transition metal hydrides, asymmetric hydrogenation. Olefin metathesis.

**Text Books**

1. Inorganic Chemistry (5th Edition, Oxford University Press, Oxford)
2. D M Adams, Inorganic Solids: An Introduction to Concepts in solid- Wells A.F., Structural state Structural Chemistry (John Wiley and Sons, London).
3. G E Coates, M L H Green & P Powell, Principles of Organometallic chemistry, (Chapman & Hall: UK)

**Reference Books/Materials**

1. Tristram Chivers, Ian Manners, Inorganic Rings and Polymers of the p-Block Elements : From Fundamentals to Applications (Royal Society of Chemistry)
2. P Braunstein, L A Oro and P R Raithby (editors), Metal Clusters in Chemistry (Wiley-VCH)
3. J D Woollins, Non-Metal Rings, Cages and Clusters (John Wiley & Sons)
4. L V Azaroff, Introduction to solids (Tata McGraw Hill Publishing Co. Ltd. Bombay- New Delhi)
5. G L Miessler and D A Tarr, Inorganic Chemistry (Pearson, Delhi)
6. B Douglas, D H Mc Daniel and J J Alexander, Concepts and Models of Inorganic Chemistry (John Wiley and Sons, New Delhi)
7. D W Breck, Zeolites Molecular Sieves- Structure, Chemistry and Use (John Wiley & Sons, N. Y.)
8. M L H Green, Organometallic compounds (Chapman & Hall: UK)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination  
Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH704</b>	<b>Spectroscopy of Organic Compounds</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Graduation level Chemistry				
<b>Co-requisites</b>	--				

**Course objective:** Analysis of the given chemical compound is most important and tedious task in chemistry. In this course the students will be exposed to

1. The principles, instrumentation and applications of infrared spectroscopy which is helpful in identification of functional groups.
2. laws of spectrophotometry and applications of ultraviolet spectrophotometer for analysis of unsaturated organic compounds
3. application of nuclear magnetic and mass spectroscopy for structure and molecular weight determination respectively

### Catalog Description

Spectroscopy is a very powerful tool used for characterization and identification of structure of organic compounds. Good understanding of this spectroscopy will enable students to decipher the structure of organic compounds by simple analysis of IR/NMR and mass spectra. The technique is also beneficial to distinguish geometric isomers, stereoisomers and help in finding purity of compounds.

### Course Content

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#### Unit I: UV-VIS and Infrared spectroscopy

Beer – Lambert's Law and molar extinction coefficient; Oscillator strength and intensity of the electronic transition; Frank Condon Principle; Ground and first excited electronic states of diatomic molecules; Relationship of potential energy curves to electronic spectra; Chromophores, auxochromes, blue shift, red shift, hypo and hyperchromic effect; Transitions in organic molecules; Woodward rules for conjugated dienes, unsaturated carbonyl groups and extended conjugation aromatic systems, Quantitative applications.

Introduction to Infrared spectroscopy; Nature of radiation; Energies corresponding to various kinds of radiation; Experimental techniques; Intensities of spectral lines; Selection rules and transition moments; Characteristic vibrational frequencies of different functional groups; Effects of H-bonding and solvent effect on vibrational frequency; Application of IR for structural elucidation.

## **Unit II: Nuclear magnetic resonance spectroscopy-I**

PMR: Natural abundance of  $^{13}\text{C}$ ,  $^{19}\text{F}$  and  $^{31}\text{P}$  nuclei; The spinning nucleus; Effect of external magnetic field; Precessional motion and frequency; Energy transitions; Chemical shift and its measurements; Factors influencing chemical shift; Anisotropic effect; Spin-spin coupling: Splitting theory, one, two and three bond coupling, virtual, long range and allylic coupling; Coupling constant; Factors affecting the coupling constant; Chemical and magnetic equivalence; First and second order spectra:  $A_2$ , AB, AX,  $AB_2$ ,  $AX_2$ ,  $A_2B_2$  and  $A_2X_2$  spin systems; Simplification of complex spectra (solvent effect, field effect, double resonance and lanthanide shift reagents); Continuous Wave and Fourier Transform NMR; Relaxation processes; T1 and T2 measurements; Applications of PMR in structural elucidation of simple and complex compounds.

## **UNIT III: Nuclear magnetic resonance spectroscopy-II**

$^{13}\text{C}$ -NMR: Resolution and multiplicity of  $^{13}\text{C}$  NMR;  $^1\text{H}$ -decoupling, Noise decoupling; Broad band decoupling; Deuterium, fluorine and phosphorus coupling; origin of nuclear Overhauser effect; Off-resonance, proton decoupling; Structural applications of  $^{13}\text{C}$ -NMR.; Pulse sequences, pulse widths, spins and magnetization vectors; Distortion less Enhancement by Polarization Transfer (DEPT) ; Insensitive nuclei enhanced by polarization transfer (INEPT) Introduction to 2D-NMR: Correlation spectroscopy (COSY) and Nuclear overhauser effect spectroscopy (NOESY) spectra.

## **Unit IV: Mass spectra**

Introduction, methods of ionization EI & CI; Brief description of LD, FAB, SIMS, FD etc.; Ion analysis methods (in brief); Isotope abundance; Metastable ions; General rules predicting the fragmentation patterns; Nitrogen rule; Determination of molecular ion peak; Fragmentation patterns for aliphatic compounds, amines, aldehydes, Ketons, esters, amides, nitriles, carboxylic acids, ethers, aromatic compounds etc.

### **Textbooks:**

1. Y R Sharma, Elementary Organic Spectroscopy (S. Chand)
2. W Kemp, Organic Spectroscopy (McMillan Press Ltd, London)

### **Reference Books:**

1. C N Banwell and E M McCash, Fundamentals of Molecular Spectroscopy (Tata McGraw- Hill, New Delhi)
2. R M Silverstein, G C Basseler and T C Morill Spectroscopic Identification of Organic Compounds (John Wiley and sons, Inc. New York)
3. J R Dyer, Applications of Absorption Spectroscopy of Organic Compounds (Prentice Hall)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

**Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH706</b>	<b>Quantum Chemistry and Chemical Kinetics</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

1. To explain how quantum mechanical systems differ from classical systems.
2. To learn to solve the Schrodinger equation for model systems and atoms.
3. To determine rate law of chemical change based on experimental data.
4. To apply integrated rate equations to solve for the concentration of chemical species during a reaction of different orders.

### Catalog Description

This course imparts the basic concepts of quantum chemistry and chemical kinetics. It enables the students to understand wave functions and principles based on quantum chemistry. They will be exposed to several quantum mechanical operators with special emphasis on linear and angular momentum operators. The course will discuss the rate of chemical reactions and the laws used in chemical kinetics. The students will also learn about the concepts of enzyme catalysis and its mathematical treatment.

### Course Content

#### Unit I:

**8 Lectures**

Uncertainty principle, postulate of quantum mechanics, properties of wave functions, Schrodinger equation, wave function and its interpretation. Normalization and orthogonality, Eigen functions and Eigen values. Solutions of wave equation for a free particle and particle in a box problem. Transition dipole moment integral and selection rules. Application to electronic spectra of conjugated linear organic molecules.

#### Unit II:

**12 Lectures**

Linear and angular momentum, Eigen function and Eigen values of angular momentum operator, Ladder operator, addition of angular momenta. Spin angular momenta, symmetric and antisymmetric wavefunctions, Pauli Exclusion Principle, spectroscopic term symbols.



**Unit III:****12 Lectures**

The rates of reaction, reaction rate, rate laws & rate constants, the determination of the rate law, first order, second order reactions, half-lives, fractional order reactions. Accounting for rate laws, simple reactions, the temperature dependence of reaction rates, reactions approaching equilibrium, consecutive reactions, the steady state approximations, pre equilibria, unimolecular reactions.

**Unit IV:****8 Lectures**

The kinetics of complex reactions: chain reaction- explosion, photochemical reactions quantum efficiency, fast reactions-flash photolysis, flow techniques, relaxation methods. Enzyme catalysts: Michaelis-Menten mechanism, limiting rate, Lineweaver Burk and Eadie plots enzyme inhibition, competitive and non-competitive inhibition.

**Text Books**

1. A K Chandra, Introductory Quantum Chemistry (Tata McGraw-Hill)
2. I N Levine, Quantum Chemistry (Pearson Educ., Inc., New Delhi)
3. Donald A. McQuarrie, Quantum Chemistry (Viva Books, New Delhi)
4. P W Atkins, Physical Chemistry (Oxford University press)
5. A A Frost and R G Pearson, Kinetics and Mechanism (ACS publications)

**Reference Books/Materials**

1. W Kauzmann Quantum Chemistry (Academic press)
2. S Glasstone, Theoretical Chemistry: An introduction to quantum mechanics, statistical mechanics, and molecular spectra for chemists (D. Van Nostrand Company, Inc.)
3. R K Prasad, Quantum Chemistry (New Age International, New Delhi)
4. K J Laidler, Chemical Kinetics (Pearson Education)
5. G L Agarwal, Basic chemical Kinetics (Tata-McGraw Hill)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCS 714</b>	<b>COMPUTER APPLICATIONS IN CHEMISTRY</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Computer Fundamentals				
<b>Co-requisites</b>	--				

### Course Objectives

1. Basic information regarding computer and computing application of internet
2. Programming in computers and C language for chemist.
3. To develop competences of students in using computers to solve problems related to Chemistry.
4. To introduce IT in a simple language to all undergraduate students, regardless of their specialization.
5. To pursue specialized programs leading to technical and professional careers and certifications in the IT industry.
6. To introduce skills relating to IT basics, computer applications, programming, interactive media, Internet basics, etc.
7. To develop good programming skills and to develop problem solving skills.

### Catalog Description

Computing and programming is essential to leverage the technical skills of a student. These techniques equip the students with know-how of the latest technologies and reduce considerable time in solving problems. The course of computer applications in chemistry has become essentially the present age of computer technology and information, as the applications of information technology in chemistry can be found in all aspects of our lives.

### Course Content

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#### Unit I:

**18 Lectures**

#### Introduction to Computers and Computing

Basic structure and functioning of computers with a PC as an illustrative example. Memory, I/O devices. Secondary storage. Computer language. Number System binary, octal, hexadecimal and their interconversions, memory management. Operating systems with DOS as an example. Introduction to UNIX and WINDOWS, MSOffice, Data Processing, principles of programming. Algorithms and flow-charts.

**Unit II: 12 Lectures****Introduction to Networking**

(a) Introduction – Server, client and parts, server and network operating system, network cards, cabling and hubs, maintenance and connecting to internet.

(b) Features and concepts of e-mail technology – Message headers, Address book, Attachment, Filtering and forwarding mails.

(c) Application of Internet for Chemistry with search engines, various types of files like PDF, JPG, RTF and Bitmap. Scanning, OMR, Web camera.

**Unit III: 8 Lectures****Computer Programming in C**

Overview of C, Constants, Variables, and Data Types, Operators and Expression, Managing Input and Output Operators, Decision Making and Branching, Single and two dimensional arrays, structure, IF statement, IF...ELSE statement, GO TO statement, Decision Making and Looping, WHILE statement, DO statement and FOR statement, Jumps in loop.

**Unit IV: 8 Lectures****Programming in Chemistry**

Development of small computer codes involving simple formulae in chemistry, such as Vander Waals equation, titration, kinetics, radioactive decay. Evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equations to solve secular equations within the Huckel theory. Elementary structural features such as bond lengths.

**Textbooks:**

1. Pundir & Bansal, Computer of Chemists (Pragati Prakashan)
2. V Rajaraman and T Radhakrishnan, An Introduction to Digital Design (Prentice Hall)

**Reference Books:**

3. R Kumari, Computer and their application to chemistry (Springer)
4. R Hunt and J Shelley, Computer and Common Sense (Prentice Hall)
5. A C Norris, Computational Chemistry (Wiley, New York)
6. J P Killngbeck, Microcomputer Quantum Mechanics (Adam Hilger)
7. V Rajaraman, Computer Programming in FORTRAN IV (Prentice Hall)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH756</b>	<b>Inorganic Chemistry-II Lab</b>	L	T	P	C
<b>Version 1.0</b>		0	0	4	2
<b>Pre-requisites/Exposure</b>	Qualitative analysis of lanthanides and metal ions				
<b>Co-requisites</b>	--				

### Course Objectives

1. To strengthen the students with semi micro analysis.
2. To expertise the students in qualitative analysis of complex inorganic mixture.

### Catalog Description

This course imparts the understanding of qualitative analysis of complex inorganic mixture by semi micro analysis which enables them to identify lanthanide and transition metal ion in a given mixture. This course helps them to get experience of selecting suitable test procedure for identification of ion by using gravimetric, volumetric and spectrophotometric techniques. The course also introduces the use of paper chromatography technique.

### Course Content

#### (a) Qualitative Analysis of Inorganic Mixture:

Identification of seven radicals including insoluble residue and rare earth metal ions by semi micro analysis.

- (i) Rare elements: Tl, W, Se, Mo, Ti, Zr, Ce, Th, V, U, Li
- (ii) Insolubles: PbSO<sub>4</sub>, SrSO<sub>4</sub>, Al<sub>2</sub>O<sub>3</sub>, Cr<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, SnO<sub>2</sub>, AgX, TiO<sub>2</sub>, ThO<sub>2</sub>, WO<sub>2</sub>.xH<sub>2</sub>O

#### b) Quantitative analysis of tri-component mixture of metal ions using gravimetric, volumetric and spectrophotometric techniques.

- (i) Mixed solution of Cu<sup>2+</sup>, Ni<sup>2+</sup> and Zn<sup>2+</sup>
- (ii) Mixed solution of Ni<sup>2+</sup>, Zn<sup>2+</sup> and Fe<sup>2+</sup>

### Textbooks

4. A I Vogel, A text book of Quantitative Inorganic Analysis (Prentice Hall)

### Reference Books/Materials

5. W G Palmer, Experimental Inorganic Chemistry (Cambridge : University Press)
6. V V Ramanujam, Inorganic Semi-Micro Qualitative Analysis (The National Publishing House, Chennai)
7. J Bassett, R C Denny, G H Jeffery and J Mendham, Vogel's Textbook Of Quantities Analysis, Revised (ELBS)

### Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH754</b>	<b>Organic Chemistry-II Lab</b>	L	T	P	C
<b>Version 1.0</b>		0	0	4	2
<b>Pre-requisites/Exposure</b>	Graduation level Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

1. To enable the student for hands on learning by experiments.
2. To generate confidence among students to perform reactions or analysis.

### Catalog Description

In this course, the focus will be on thorough hand on practice to double stage synthesize organic compounds. Student will have exposure of estimation of organic compounds and characterization of oils via saponification value and iodine value.

### Course Content

#### List of experiments:

1. Estimation of phenol/aniline using bromate-bromide solution.
  2. Determine the number of hydroxyl and amino groups in the given sample by the acetylation method.
  3. Determination of mol. wt. of the given ketone by using 2, 4-DNP method.
  4. Estimation of reducing sugar by Fehling solution method.
  5. Determination of the saponification value of the given fat or oil sample.
  6. Determination of the iodine number of the given fat or oil sample.
  7. Determination of concentration of organic compounds by using UV-VIS spectrophotometer.
  8. Preparation of organic compounds (Double stage)
    - a) benzanilide from benzophenone (rearrangement).
    - b) p-bromoaniline from acetanilide (bromination and hydrolysis).
    - c) m-nitroaniline from nitrobenzene (nitration and reduction).
    - d) 1,2,4-triacetoxy benzene from hydroquinone (oxidation and acylation).
    - e) p-bromo acetanilide from aniline (acetylation and bromination).
- (Any suitable Expt. may be added)

**Practical Books:**

1. R M Roberts, J C Gilbert, L B Rodewald and A S Wingrove Holt, An Introduction to Modern Experimental Organic Chemistry (Ranehart and Winston Inc. New York)
2. D L Pavia, G M Lampmana and G S Kriz, Introduction to Organic Laboratory Techniques – A Contemporary Approach (W. B Saunders Company, 1976)
3. R Adams, J R Johnson and C F Wilcox, Laboratory Experiments in Organic Chemistry (The Macmillan Limited, London)
4. B S Furniss, A J Hannaford, P W G Smith and A R Tatchell ELBS with Longman, Vogels Textbook of Practical Organic Chemistry (Longman Singapore Publishers Pt Ltd, Singapore)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

**Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>Version 1.0</b>		0	0	4	2
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

1. To learn about equilibrium and study it experimentally.
2. To perform time-bound experiments in order to do kinetic studies.
3. To conceptualise the theory behind potentiometric titrations.
4. To understand the phase rule and the basic theory behind phase diagrams.

### Catalog Description

This course imparts the basic concepts of physical chemistry experiments. It enables the students to perform several experiments based on chemical kinetics. The course helps the students to understand the experimental importance of polarimetry and potentiometry. The course introduces several different kinds of titrations.

### Course Content

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#### List of experiments:

1. Polarimetry: Kinetics of inversion of cane sugar in presence of strong acid.
2. Chemical Kinetics: Kinetics of reaction between bromate and iodide.
3. Kinetics of iodination of acetone in presence of strong acid etc.
4. Phase diagram of a binary organic system (Naphthalene and Diphenyl).
5. Potentiometric titration of a strong acid with strong base using quinhydrone electrode
6. Rate constant of acid catalyzed hydrolysis of sucrose by chemical method.
7. Degree of hydrolysis of urea hydrochloride by kinetics method.
8. Equilibrium constant of  $KI + I_2 \rightleftharpoons KI_3$  by distribution method.
9. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi – and trivalent anions.
10. Titrate a moderately strong acid(salicylic/mandelic acid) by the
  - (i) Salt-line method
  - (ii) Double alkali method.
1. Titrate
  - (i) magnesium sulphate against  $BaCl_2$  and its reverse titration
  - (ii)  $HCl$  versus  $NH_4OH$ .

(Any suitable Expt. may be added.)

**Practical Books:**

1. B Viswanathan and P S Raghavan, Practical Physical Chemistry (Viva books)
2. V D Athawale and Parul Mathur, Experimental Physical Chemistry (New Age International Pvt Ltd.)
3. A Finlay and J A Kitchener, Practical Physical Chemistry (Longman)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>



<b>BSCS762</b>	<b>COMPUTER APPLICATIONS IN CHEMISTRY LAB</b>	L	T	P	C
<b>Version 1.0</b>		0	0	2	1
<b>Pre-requisites/Exposure</b>	Basics of Computer Fundamentals				
<b>Co-requisites</b>	--				

### Course Objectives

1. Basic information regarding computer and operating system.
2. Programming in computers and C language for chemist.
3. To develop competences of students in using computers to solve problems related to Chemistry using ChemOffice Ultra.
4. To introduce IT in a simple language to all undergraduate students, regardless of their specialization.
5. To pursue specialized programs leading to technical and professional careers and certifications in the IT industry.
6. To introduce skills relating to IT basics, computer applications, programming, interactive media, Internet basics, etc.
7. To develop good programming skills and to develop problem solving skills.

### Catalog Description

The course aims to develop competences of students in using computers to solve problems related to Chemistry. Computing and programming is essential to leverage the technical skills of a student. These techniques equip the students with know-how of the latest technologies and reduce considerable time in solving problems. The course of computer applications in chemistry has become essentially the present age of computer technology and information, as the applications of information technology in chemistry can be found in all aspects of our lives.

### Course Content

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#### List of experiments:

1. Computer Fundamentals (Operating Systems e.g. MSDOS, Windows, LINUX).
2. Introduction and application about the computational chemistry & molecular modeling software.
3. Understanding of the chemical structure and physico-chemical properties using chemistry software "ChemOffice Ultra"
  - a) Draw a chemical structure and reactions with the example of organic and inorganic substances along with physical notations such as bonding, enthalpy, entropy, etc.
  - b) Concept, application and handling of 2D & 3D structure. Draw the structures of biological active molecules.

4. Understand the concept of stereochemistry and draw the stereo chemical structure by using the example of nucleoside and amino acid.
5. Minimization of the chemical structure with the example of nucleoside.
6. Compute the structural and physico-chemical properties (e.g.; bond length, bond angle, dihedral angle, conformation, partial charge, steric energy, etc.) of the target molecule using Chem Draw Tools.  
(Any suitable Expt. may be added)

**Practical Books:**

1. Ramesh Kumari, Computers and Their Applications to Chemistry (Narosa publications)
2. R Hunt and J Shelley, Computer and Common Sense (Prentice Hall)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

### SEMESTER III

<b>BSCH807</b>	<b>Coordination Chemistry and Inorganic Polymer Chemistry</b>	L	T	P	C
<b>Version 2.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Coordination Chemistry and Polymers				
<b>Co-requisites</b>	--				

#### Course Objectives

1. To learn the students about the coordination compounds
2. To learn the students concepts and methods to find out the isomerism in coordination complexes
3. To think across and beyond existing chemistry of coordination complexes
4. To communicate clearly and competently matters of color and magnetic properties of coordination complexes
5. Understand basic aspects of the solution properties of polymers, interactions and the relationship to chemical structure, including phase behaviour and the measurement of molecular weight.

#### Catalog Description

This course imparts the basic knowledge of coordination chemistry including their naming, bonding on the basis of valence bond theory and crystal field theory, structure. This course helps them to get an idea about the stereochemistry of coordination complexes. The course introduces the concepts of magnetic and spectral properties of compounds including their colour and different types of polymerization.

#### Course Content

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##### Unit I:

**12 Lectures**

##### **Isomerism and Theories of coordination complexes**

Geometrical and optical isomerism in octahedral and square planar complexes – Stereochemistry of complexes, Magnetic properties – Dia, para, ferro and antiferro magnetisms - Curie's law – Spin isomerism. Stability constants of complexes and their determination.

Crystal field theory (CFT), Crystal field splitting in octahedral, tetrahedral and square planar complexes, Crystal field stabilization energy and its applications, Weak and strong fields, Pairing energy, Factors affecting the magnitude of crystal field splitting. Limitations of CFT. Adjusted crystal field theory (ACFT) (also called Ligand Field Theory), Molecular orbital (MO) theory for octahedral, tetrahedral and square planar complexes.

**Unit II:****10 Lectures****Reaction Mechanism**

Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, A, D and I mechanism for metal complexes, Acid hydrolysis, factors affecting acid hydrolysis, Base Hydrolysis, Anation reactions, Substitution reactions in square planer complexes, Mechanism of the substitution reaction, the trans effect, Redox Reaction, Electron Transfer Reactions: Mechanism of one electron transfer reactions, outer sphere type reactions. Cross reactions and Marcus-Hush theory, Inner sphere types reactions.

**Unit III:****14 Lecture****Electronic Spectra and Magnetic Properties**

Quantum numbers of multi-electron atoms, Russell-Sanders coupling, L-S coupling and micro states, Ground state terms for  $d^1 - d^{10}$  ions, Derivation of terms for  $p^2$ ,  $p^3$ ,  $d^1$  and  $d^2$  configurations, Hund's rules in the determination of lowest energy states, Selection rules for electronic transitions, Charge transfer transitions. Splitting of free ion terms in octahedral field, correlation diagram, Orgel diagrams for  $d^1$  to  $d^9$  ions and Tanabe-Sugano diagrams for  $d^2$  and  $d^3$  ions.

**Unit IV:****12 Lecture****Inorganic Polymers**

Charecterestic properties and Classification;- Types of Inorganic Polymerization (step-growth, chain-growth, ring-opening, Reductive Coupling, Condensation synthesis )- Synthesis, properties and applications of important inorganic polymers: Polyphosphazenes , phosphonitrilic halides. Polysiloxanes (Silicones), polysilanes. Coordinate Polymers.- Condensed Phosphates, Silicates, and sulphur-nitrogen compounds.- Isopoly and Hetropoly acid and Salts : Synthesis and structural principles with reference to those of Mo and W.

**Textbooks**

1. J E Huheey, E A Keither and R L Keiter, Inorganic Chemistry (Harper Collins College Publisher, New York)
2. Geoffrey A Lawrance, Introduction to Coordination Chemistry (Wiley & Sons)

**Reference Books/Materials**

1. G L Miessler and D A Tarr, Inorganic Chemistry (Pearson, Prentice Publishers, Delhi)
2. D F Shriver, P W Atkins and C H Langford, Inorganic Chemistry (ELBS, Oxford University Press)
3. B Douglas, D H Mc Daniel and J J Alexander, Concepts and Models of Inorganic Chemistry (John Wiley and Sons, New Delhi)
4. Robert B Jordan, Reaction Mechanisms of Inorganic and Organometallic System, (Oxford University Press)
5. Yves Jean, Molecular Orbitals of Transition Metal Complexes (Oxford University Press)
6. C H Langford & H B Gray, Ligand Substitutin Processes (W. A. Benjamin Inc.)
7. Fred Basolo, Ralph G Pearson, Mechanisms of Inorganic Reactions (Wiely Eastern Ltd.)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination  
Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/ Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH803</b>	<b>Heterocyclic, Photochemistry And Pericyclic Chemistry</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	12 <sup>th</sup> level Chemistry				
<b>Co-requisites</b>	--				

## Course Objectives

In this course students will learn and understand

1. Fundamental principals involved in photochemistry.
2. Classification and nomenclature of heterocyclic compounds, their synthesis and reactions.
3. Concept of photochemistry as applicable to different organic molecules.
4. Chemistry of pericyclic reactions

## Catalog Description

Heterocyclic molecules are organic cyclic molecules containing heteroatoms. They are important from the point of view that most of the medicines are derived from heterocyclic molecules. The course gives an understanding about their properties and methodology of their synthesis. Moreover, understanding of photochemical and pericyclic reactions is provided in this course on the basis of molecular orbital symmetry.

## Course Content

### Unit I: Heterocycles-I

Hantzsch-Widman nomenclature for monocyclic, fused and bridged heterocycles; General approaches to heterocyclic synthesis; Aliphatic and aromatic heterocycles; Basicity and aromaticity of heterocycles; Syntheses of aziranes, oxiranes and thiranes; Ring openings and heteroatom extrusion; Synthesis and reactions of azetidines, oxetanes and thietanes; Strain.

### Unit II: Heterocycles-II

Structural and chemical properties of azoles; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis of imidazoles, thiazoles and oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages; Benzofused analogues. Synthesis of indole and benzofuran; Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology.

Structure, chemical properties (Nucleophilic and electrophilic substitutions) and synthesis of pyridazines, pyrimidines, pyrazines; Synthesis of benzopyrans, quinolines, isoquinolines, benzofused diazines, acridines, phenothiazines and their substitution reactions; Synthesis and reactions of azepines, oxepines. Chemistry of porphyrins and spiro heterocycles.

### Unit III: Photochemistry

Interaction of electromagnetic radiation with matter; Types of excitations; Fate of excited molecule; Quantum yield; Transfer of excitation energy; Actinometry.

Photochemistry of alkenes and carbonyl compounds: Photooxygenation; Photochemistry of aromatic compounds: Photochemical isomerisation, addition and substitution; Photo-Fries rearrangement of ethers and anilides; Barton reaction; Hoffmann-Loeffler-Freytag reaction; Di- $\pi$ -methane rearrangement; Singlet molecular oxygen reactions; Photo-cleavages.

#### Unit IV: Pericyclic Reactions

Molecular orbitals: MOs of acyclic and cyclic polyenes and arenes; Classification of pericyclic reactions; Thermal and photochemical reactions; Woodward-Hoffman rules; Three approaches: Conservation of orbital symmetry and correlation diagram, Frontier molecular orbital approach [FMO] and aromatic (Huckel and Mobius) transition state approach.

Cycloaddition reactions:  $4n$  and  $4n+2$   $\pi$  electron systems; Diels-Alder reactions: 1, 3-Dipolar cycloadditions and cheletropic reactions; The ene reactions. Electrocyclic reactions: Conrotatory and disrotatory motions,  $4n$  and  $4n+2$   $\pi$  electron systems and other systems; Valence tautomerism.

Sigmatropic rearrangements: H-shifts and alkyl-shifts, supra and antarafacial migrations; Cope and Claisen rearrangements; Degenerate Cope rearrangement; Fluxional tautomerism; Wittig rearrangement; 2, 3-sigmatropic shifts.

#### Textbooks:

1. T L Gilchrist, Heterocyclic Chemistry (Dorling Kindersley ( India) Pvt. Ltd., New Delhi)
2. C H Depuy and O L Chapman, Molecular Reactions and Photochemistry (Prentice-Hall of India ( P) Ltd., New Delhi)

#### Reference Books:

1. L A Paquette, Principles of Modern Heterocyclic Chemistry (W. A. Benjamin, Inc. New York)
2. I L Finar, Organic Chemistry: Stereochemistry and Chemistry of Natural Products, Vol. II (ELBS with Longman, London)
3. C E Wayne and R P Wayne, Principles and Applications of Photochemistry (Oxford University Press, Oxford)
4. N J Turro, Modern Molecular Photochemistry (University Science Books. California)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

#### Examination Scheme:

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH805</b>	<b>Polymers</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry (Graduation level)				
<b>Co-requisites</b>	--				

### Course Objectives

1. To learn the properties of micelles and reverse micelles.
2. To study the reaction mechanisms involved in polymer synthesis and the kinetics of these reactions.
3. To describe different types of polymerisation process, and the significance in each of: initiation, propagation, and termination.
4. To understand copolymerisation and reactivity ratios associated with it.

### Catalog Description

The topics included in this course will help students to study the classification and properties related to the polymers. They will learn about micelle formation above cmc. They will also study about the thermodynamics associated with the process of micellization. This course also includes detailed study of kinetics and mechanism of the polymerisation process and uses of polymers.

### Course Content

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#### Unit I:

**8 Lectures**

Micelles and Macromolecules: Surface active agents and their classification, micellization, hydrophobic interaction, critical micellar concentration (cmc), factors affecting cmc of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, micro emulsions, reverse micelles.

#### Unit II:

**12 Lectures**

Macromolecules:

Introduction: Classification and nomenclature of polymers, composition and polymerization mechanism. Step Polymerization : Reactivity of functional groups, basis for analysis of polymerization, kinetics of step polymerization, self catalysed polymerization, external catalysis of polymerization, step polymerization other than polyesterification non-equivalence of functional groups in polyfunctional reagents.

Radical chain polymerization : Overall kinetics of chain polymerization, initiation, thermal decomposition of initiators, types of initiators, kinetics of initiation and polymerization, dependence of polymerization rate on monomer, photochemical initiation, initiation by ionizing radiation, pure thermal initiation, redox initiation.



**Unit III:****12 Lectures**

Co-polymerization and emulsion polymerization: The composition of addition copolymers, kinetics of chain propagation in co-polymerization, qualitative and quantitative theories of emulsion. Polymerization rate, degree and number of polymer particles in emulsion polymerization.

**Unit IV:****8 Lectures**

Molecular weight average and viscosity average molecular weight, molecular weight determination by osmotic method, light scattering method, sedimentation method, diffusion constant, sedimentation equilibrium, viscosity method. Statistics of Linear polymers Molecular weight, molecular weight distribution, polydispersity index, average and end to end distance, average radius of gyration. Conducting polymers.

**Textbooks**

1. F W Billmeyer, Text Book of Polymer Science (Wiley-Interscience, New York)
2. Paul J Flory, Principles of Polymer Chemistry (Cornell University Press)

**Reference Books/Materials**

1. V. Moroi, Micelles, Theoretical and Applied Aspects (Plenum)
2. V R Gowariker, N V Vishwanathan and J Sridhar, Introduction to polymer Science (Wiley eastern)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

**Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH851</b>	<b>Inorganic Chemistry – III Lab</b>	L	T	P	C
<b>Version 1.0</b>		0	0	4	2
<b>Pre-requisites/Exposure</b>	Basics of titrations, coordination chemistry and analytic techniques				
<b>Co-requisites</b>	--				

### Course Objectives

1. To learn students about determination of metal content present in ore/ minerals by quantitative analysis
2. To learn students about the analytical techniques like colorimetry, conductometry.
3. To differentiate between stepwise and overall stability of coordination complexes and their determination.
4. To give hand on experience of analytical techniques.

### Catalog Description

This course imparts the quantitative analysis minerals and alloys for determination of metal content by different methods like by simple titration method, iodometry method and colorimetry. This course introduces the synthesis of coordination complexes and helps them to determine the stability constant of coordination chemistry.

### Course Content

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#### List of experiments:

##### (a) Quantitative analysis of minerals/alloys

1. Analysis the given brass (50-70% Cu+20-40%Zn+0-6%Sn+0-2%Pb+0-1%Fe) sample for its Cu and Zn contents colorimetrically. Alternatively, Cu by iodometry and Zn by EDTA method.
2. Analysis of the given sample of gun metal (90% Cu+10%Sn) for its Cu content by iodometry.
3. To determine ferrous content in the supplied sample of iron ore/rust/steel volumetrically against standard potassium dichromate solution using potassium ferricyanide as external indicator.
4. Analysis of the given sample of dolomite (equimolar  $\text{CaCO}_3+\text{MgCO}_3$ ) for its volatile matter, insoluble matter, and its Ca & Mg contents by EDTA method.

**(b) Determination of Stability Constant of Complexes**

- (i) The stepwise and the overall stability constants of Cu (II) Sulpho salicylic Acid Complexes.  
(ii) The stepwise and the overall stability constants of Mn (II)-Amino Acid (eg Glycine) Complexes.

**(c) Synthesis of coordination complexes using vacuum technique.**

(Any suitable Expt. may be added)

**Practical Books:**

1. A I Vogel, A text book of Quantitative Inorganic Analysis (Prentice Hall)
2. W R Schoeller and A.R. Powell, The analysis of minerals and ores of the rarer elements (Charles, Griffin and Company Limited)
3. V I Posypaiko and N A Vasiua, Analytical Chemistry in Metallurgy (Mir Publishe, Moscow)
4. W G Palmer, Experimental Inorganic Chemistry (Cambridge : University Press)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH853</b>	<b>Organic Chemistry-III Lab</b>	L	T	P	C
<b>Version 1.0</b>		0	0	4	2
<b>Pre-requisites/Exposure</b>	Graduation level Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

The primary objective of this course is to acquaint students with methods of synthesis of organic molecules by multi step reactions and their purification techniques.

### Catalog Description

Synthesis of organic molecules is an important task in chemistry and this course provides an opportunity to students to apply their theoretical knowledge to prepare dyes, heterocyclic and other molecules in laboratory.

### Course Content

#### List of experiments:

1. Purification of tertiary mixtures of amino acids by paper chromatography.
2. Extraction of natural products: Any one of the following – solasodine, caffeine, nicotine, piperine, rosine, carotenoids.
3. Synthesis of heterocyclic compounds.
4. Synthesis of dyes
5. Multistep Organic Synthesis:
  - a) Synthesis of 2-chloro-4-bromoaniline from aniline (Bromination and chlorination)
  - b) Synthesis of methyl orange from aniline (Aromatic electrophilic substitution and diazocoupling).
  - c) Synthesis of benzpinacol and its pinacolone rearrangement.
  - d) Synthesis of o-chlorobenzoic acid from phthalimide (Hofmann bromamide and Sandmeyer's reaction).
  - e) Synthesis of acridone from o-chlorobenzoic acid. (Hofmann bromamide and Sandmeyer's reaction).
  - f) Synthesis of 2,4-dinitrophenyl hydrazine from chloro benzene. (Electrophilic and nucleophilic substitution reactions on aromatic ring).
  - g) Synthesis of triphenylcarbinol from bromobenzene. (Grignard reaction)
 (Any suitable Expt. may be added.)

**Practical Books:**

1. R M Roberts, J C Gilbert, L B Rodewald and A S Wingrove Holt, An Introduction to Modern Experimental Organic Chemistry (Ranehart and Winston Inc. New York)
2. D L Pavia, G M Lampmana and G. S. Kriz, Introduction to Organic Laboratory Techniques – A Contemporary Approach (W. B. Saunders Company, 1976)
3. R Adams, J R Johnson and C F Wilcox, Laboratory Experiments in Organic Chemistry (The Macmillan Limited, London)
4. B S furniss, A J Hannaford, P W G Smith and A R Tatchell ELBS with Longman, Vogels Textbook of Practical Organic Chemistry (Longman Singapore Publishers Pvt. Ltd, Singapore)
5. J R Mohrig, C N Hammonad, P F Schatz and T C Morrill, Modern Projects and Experiments in Organic Chemistry (W.H. Freeman and Company, New York)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

**Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH855</b>	<b>Physical Chemistry-III Lab</b>	L	T	P	C
<b>Version 1.0</b>		0	0	4	2
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

1. To learn the theory behind potentiometric titrations.
2. To calculate dissociation constant of weak acids making use of absorbance values.
3. To perform time-bound experiments in order to do kinetic studies.
4. To learn the necessary calculations to get the viscosity value from the time of flow.

### Catalog Description

This course imparts the basic concepts and protocols of experiments based on viscometry, potentiometry, colorimetry, and spectrophotometry. It enables them to perform adsorption studies and plot the respective isotherm, Freundlich, as well as, Langmuir. It also discusses about physical parameters, like distribution coefficient and critical solution temperature.

### Course Content

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#### List of experiments:

1. Determine the molecular weight of a given macromolecule (PVP) by the viscosity method.
2. Determine the dissociation constant of an indicator colourimetrically.
3. Determine the stability constant of the lead oxalate complex by polarographic method.
4. Titrate potentiometrically a solution of ferrous ions against  $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ . Carry out the titration in the reverse order.
5. Determination of partition coefficient of iodine between carbon tetrachloride and water.
6. Determination of rate control and order of reaction of hydrolysis of an ester (Methyl acetate) catalyzed by an acid (dilute HCl).
7. To determine the adsorption of aqueous acetic acid by activated charcoal and to study the adsorption isotherm.
8. Determine the dissociation constant of an indicator spectrophotometrically.
9. Record the UV spectrum of a given compound (acetone) in cyclohexane.
  - (i) Plot transmittance versus wavelength.
  - (ii) Plot absorbance versus wavelength.

10. To determine the adsorption of aqueous acetic acid by activated charcoal and to study the adsorption isotherm.
11. To determine the CST of phenol – water system.

### **Practical Books**

1. B Viswanathan and P S Raghavan, Practical Physical Chemistry (Viva books)
2. V D Athawale and Parul Mathur, Experimental Physical Chemistry (New Age International Pvt Ltd.)
3. A Finlay and J A Kitchener, Practical Physical Chemistry (Longman)

### **Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH802</b>	<b>Chemistry of Materials</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of solid state and inorganic materials				
<b>Co-requisites</b>	--				

## Course Objectives

1. To learn the students about solid state and defects of crystals
2. To learn the students about synthesis methods like sol-gel, precipitation techniques, high temperature and high pressure synthesis.
3. Acquire the knowledge of magnetic and electronic properties of inorganic materials.
4. Understand about the analytic techniques like electron microscopy, atomic force microscopy.

## Catalog Description

This course helps the students to interpret difference between nanomaterials and bulk materials and why nanomaterials are preferred over bulk materials. This course helps them to get an idea about the electronic and magnetic properties of inorganic materials with their applications.

## Course Content

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### UNIT I:

**12 Lectures**

Introduction to the solid state, metallic bond, Band theory (Zone model, Brillouin Zones, Limitations of the Zone model); Defects in solids, Perfect & imperfect crystals, point defects, Line defect and plane defect (definition & explanation of meaning) order & disorder phenomena, Determination of defect, Nonstoichiometric defect (structural and thermodynamic aspects) incorporation of stoichiometric excess of defects, thermodynamics of Nonstoichiometric phases.

### Unit II:

**14 Lectures**

#### **Synthesis of Inorganic materials:**

Synthesis of solidstate materials using different techniques ceramic techniques, co precipitation techniques, sol gel techniques, precursor techniques, high temperature & high pressure synthesis.

#### Ionic Conductors-

Types of ionic conductors, mechanism of ionic conduction, interstitial jumps, vacancy mechanism, diffusion, super ionic conductors, phase transition & mechanism of conduction in super ionic conductors, examples and applications of ionic conductors.



**Unit III:****16 Lectures****Electronic properties of materials:**

- Organic semiconductors, examples, properties and application
- Superconductivity, superconductivity in metals, alloys and ceramics materials (mixed oxides) BCS theory, Meissner effect, type I & II superconductors, application of Fullerenes as superconductors.
- Dielectric polarization: piezoelectricity and Ferro electricity.
- Lasers and Masers actions, laser production and application.

**Magnetic properties of Materials-**

Introduction, Magnetization, Electron spin and magnetic moment, Theory of diamagnetism, Langevin theory & paramagnetic susceptibility of solids, ferromagnetism, Domain theory. Hysteresis in magnetism, ferrimagnetisms (ferries) Applications of magnetic materials.

**UNIT-IV:****12 Lectures****Advanced Inorganic Materials:**

Solid state Lasers (Ruby, YAG and tunable lasers): Inorganic phosphor materials, Synthesis and advantages of optical fibres over conducting fibres, Diffusion in solids, catalysis and zone refining of metals.

Preparation of nanomaterials and their characteristic differences over bulk materials, Principles of electron microscopy, Dynamic light scattering, Atomic force Microscopy and characterization of nanomaterials.

**Textbooks:**

1. Wilcox, Preparation and Properties of Solid State Materials: Vol I & II (Dekker)
2. H V K Keer, Principles of the Solid State Chemistry (Wiley Eastern)

**Reference Books:**

1. Paul Hagenmuller, Preparative Methods in Solis State Chemistry (Elsevier)
2. Lohn Wulff, The Structure and Properties of Materials Vol. IV, Electronic Properties (Wily Eastern)
3. N N Greenwood, Ionic Crystals, Lattice Defects and Nonstiochiometry (Butterworth's)
4. LV Azoroo and J J Brophy, Electronic Processes in Materials (MacGraw Hills)
5. T J Rey et al, The Defect Solid State (Interscience)
6. E A Kroger, Chemistry of Imprefect Crystals (Holland)
7. A R West, Solid state chemistry and its applications (John Wiley & Sons)
8. N Hannay, Treatise on solid state chemistry (Plenum)
9. G Timp Ed., Nanotechnology (Springer-Verlag: N. Y.)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination****Examination Scheme:**

Components	Quiz/A ssignm ent	Attenda nce	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH804</b>	<b>Advanced Organic Synthesis</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Graduation level Chemistry				
<b>Co-requisites</b>	--				

**Course objective:** This course provides the students

1. information regarding disconnection approach of organic synthesis.
2. oxidation- reduction reagents and reactions.

### **Catalog Description**

Organic synthesis, the art and science of constructing substances, natural or designed, whose primary element is carbon. Number of organic compounds is synthesized in the laboratories as they are used for several applications such as pesticides, food, cosmetics, essential oils, fats and oils, medicines, paints and varnishes, polymers etc. A multi-step synthesis of any organic compound requires the chemist to accomplish three related tasks. One approach to organic synthesis is retrosynthetic analysis. With this approach a chemist will start with the structure of their target molecule and progressively cut bonds to create simpler molecules. Reversing this process gives a synthetic route to the target molecule from simpler starting materials. This “disconnection” approach to synthesis is now a fundamental part of every organic synthesis course. It is very important to learn the role of stereospecificity and selectivity in the synthesis process, role of reagents and catalyst for maximum yield. Oxidation and reduction processes will also be discussed.

### **Course Content**

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#### **UNIT I: Disconnection Approach-I**

An introduction of synthons and synthetic equivalents, general principles of the disconnection approach, functional group interconversions, the importance of order of events in organic synthesis, one group C-X and two group C-X disconnections, one group C-C disconnection, chemoselectivity, regioselectivity, regiospecificity, stereoselectivity and stereospecificity.

#### **UNIT II: Disconnection Approach-II**

Reversal of polarity, amine synthesis, Synthesis of alkenes -use of Wittig reagents, use of acetylene and aliphatic nitro compounds in organic synthesis, synthesis of three membered rings, photochemistry in organic synthesis-synthesis of four membered rings , uses of ketones in organic synthesis, synthesis of five and six membered rings.

### UNIT III: Disconnection Approach-III

Principle of protection of alcoholic, amino, carbonyl and carboxylic groups, Two group C-C disconnect ion- Diels Alder reactions, 1,3-difunctionalized compounds and alpha, beta-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5 –di functionalized compounds- Michael addition, and Robinson Annellation. Disconnection approach towards the synthesis of Juvabione and their relative merits and demerits.

Total synthesis of the following compounds using disconnection approaches: Vitamin B<sub>12</sub>, Prostaglandin E<sub>2</sub>, F<sub>2a</sub>, Beta-ecodynone, Menthol, Taxol and Gandriol.

### UNIT IV: Oxidation and Reduction

Oxidation Methods (metal, nonmetal based and organic oxidation methods) CrO<sub>3</sub> (Jones reagent), PDC, PCC, , KMnO<sub>4</sub>, MnO<sub>2</sub>, NaIO<sub>4</sub>, HIO<sub>4</sub> Pb(OAc)<sub>4</sub> OsO<sub>4</sub> , RuO<sub>4</sub>, mCPBA, Sharpless epoxidation , H<sub>2</sub>O<sub>2</sub>-NaOH, ozonolysis, Oxidation involving alkoxy sulphonium salts, Swern oxidation, SeO<sub>2</sub>, Oppenauer oxidation, palladium catalyzed oxidation, Baeyer-Villiger oxidation, Woodward Prevost reaction, Dess-Martin oxidation, IBX oxidation.

Reduction Methods (hydrogenations, complex metal hydride reductions, dissolving metal reductions, other metal & nonmetal based reductions, organic reagents based reduction methods)

Catalytic hydrogenation, Pd/C, PtO<sub>2</sub>, H<sub>2</sub>/catalyst, (stereochemistry and mechanism), Wilkinson's catalyst, Boranes and Hydroboration reactions, NaBH<sub>4</sub>, NaCNBH<sub>3</sub>, Na(OAc)<sub>3</sub>BH, LAH, DIBAL, superhydrides, R<sub>3</sub>SiH, Bu<sub>3</sub>SnH, , MVP, NH<sub>2</sub>NH<sub>2</sub>, MVP reduction, etc. reductions of conjugated systems, Birch reduction, reductive fission of alcohols, Pinacol coupling, McMurry coupling, Deoxygenation of alcohols and carbonyl compounds such as Shapiro reaction.

#### Textbooks:

1. S Warren, Organic Synthesis: The Disconnection Approach (John Wiley & Sons)
2. J March, Advanced organic chemistry 4th Edn. (John Wiley)

#### Reference Books:

1. R E Ireland, Organic synthesis (Prentice-hall India, New Delhi)
2. A Jacob, Understanding organic reaction mechanisms (Cambridge Univ Press)
3. A Streitweiser, Jr and C H Heathcock, Introduction to organic chemistry (Macmillan, 1985) R A Y Jones, Physical and mechanistic organic chemistry (Cambridge Univ Press)
4. H O House and W A Benjamin, Modern synthetic reactions (California Press)
5. W Carruthers, Some modern methods of organic synthesis (Cambridge Univ. Press, London)
6. B S Thyagarajan, Mechanisms of molecular migration, Vols I & II (Pergamon Press, Oxford, 1979)
7. D Barton and W D Wallis, Comprehensive organic chemistry (Pergamon Press, Oxford)
8. I L Finar, Organic chemistry Vol. II (Longman)
9. V K Ahluwalia and R. K. Prashar, Organic reaction Mechanisms (Narosa, New Delhi)
10. W Carruther, Modern methods of organic synthesis (Cambridge University Press)

11. F A Carey and R J Sundberg. Part B – Adv. Organic Chemistry (Kluwer Academic pub.)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

**Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH806</b>	<b>Biophysical Chemistry</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry and Biology				
<b>Co-requisites</b>	--				

### Course Objectives

1. To be able to understand the structure and chemistry of various biomolecules.
2. To understand the various kinds of interactions taking place in the biological system.
3. To decipher the folding of proteins from a thermodynamic point of view.
4. To learn about various methods of separation used for biomolecules.

### Catalog Description

This course imparts the basic concepts of biophysical chemistry. It enables the students to understand the chemistry of several biomolecules. The course of biophysical chemistry helps to understand various interactions involved in the biological system (hydrophilic and hydrophobic). It also discusses the interactions between protein and ligands, and techniques to quantify this binding. The course introduces the basic concepts of separation techniques for biomolecules, like chromatography, sedimentation, electrophoresis, etc.

### Course Content

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#### Unit I:

**8 Lectures**

Introduction to biophysical chemistry: Structure of water, Amino acids, Proteins and Polynucleic acids. The peptide bonds. Isoelectric point. Conformations of polypeptide chains, primary, secondary and higher-order structures. Factors affecting analyte structure and stability- pH Effects, Temperature Effects, Effect of solvent Polarity.

#### Unit II:

**12 Lectures**

Biological relevance of chemical potential, Hydrophobic and hydrophilic interactions in biological systems. Protein-Solvent Interactions-Preferential binding, hydration and exclusion. Protein polymerization models, Protein denaturation models. Factors affecting analyte structure and stability- pH Effects, Temperature Effects, Effect of solvent Polarity.

**Unit III:****12 Lectures**

Thermodynamics of protein folding/stability by fluorescence, CD and calorimetric techniques. Binding Isotherms, Binding equilibrium, Hill equation. Binding of small ligands by biological macromolecules: Kinetics and energetics of protein-drug, protein-surfactant and DNA-drug interaction by fluorescence, CD and calorimetric methods.

**Unit IV:****8 Lectures**

Methods for separation of biomolecules: general principals, including Chromatography; sedimentation, Moving boundry sedimentation, zonal sedimentation, Electrophoreses. Chemistry of nucleic acid bases A.G.C.T and U and their synthesis, Structure of DNA. Structure of Starch, Cellulose Glycogen and Chitin.

**Textbooks**

1. L Stryer, Biochemistry(4th edn.) (W. H. Freeman & Co.)
1. A Cooper, Biophysical Chemistry (RSC)
2. U N Dash, Textbook of Biophysical Chemistry (McMillan India)

**Reference Books/Materials**

1. J P Allen, Biophysical Chemistry (Wiley-Blackwell)
2. R A Alberty, Thermodynamics of Biochemical Reactions (Wiley-Interscience)
3. S Zubay, Biochemistry (Addison-Wesley)
4. A L Lehinger, D L Nelson & M M Cox, Lehninger Principles of Biochemistry 4<sup>th</sup> Ed. (W. Freeman)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH808</b>	<b>Analytic Techniques</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of electrochemical process				
<b>Co-requisites</b>	--				

### Course Objectives

1. To learn the students e to develop the skills to understand the theory and practice of analytical techniques.
2. To provide scientific understanding of analytical techniques and detail interpretation of results.
3. To deliver an in-depth examination of the specific analytical techniques relevant to their research projects.
4. Acquire the include a detailed theoretical background, practical training and a critical understanding of the laboratory-based techniques they will apply during their research projects.

### Catalog Description

This course is introduced to bridge the gap between academics, research and industry. This course begins with a review of basic analytical technique and an introduction to general terminologies. This course contains analytical techniques along with their theory, working principal, common instrumentation and possible applications. This course will be equally beneficial to various scientific areas including, life science, chemical science, material science and environmental science.

### Course Content

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#### Unit I: 18 Lectures

##### Conductometry:

Introduction, principle, technique, electrolytic conductivity, measurement of electrolytic conductivity, conductometric titration, applications.

#### Unit II: 12 Lectures

##### Polarography and Voltammetry:

- (a) Introduction, principle, technique, D.M.E., half-wave potential, residual current, migration current, diffusion current, limiting current, applications.
- (b) Cyclic voltammetry and anodic stripping voltammetry.

#### Unit III: 8 Lectures

##### Amperometry:

Introduction, principle, types of current, technique, amperometric titrations with DME, amperometric titrations with rotating platinum micro electrode, biampero-metry, applications.

**Unit IV:****8 Lectures****Coulometry:**

Introduction, constant current coulometry, controlled potential coulometry (principle and technique), types of coulometer, applications.

**Textbooks:**

1. H H Willard, Instrumental Methods of Analysis (Wordsworth Publishing Company, Belmont, California, USA)

**Reference Books:**

1. A I Vogel, A Test book of Quantitative Inorganic Analysis (Rev. by GH Jeffery and others) (The English Language Book Society of Longman)
2. G D Christian and D Gary , Analytical Chemistry ( John Willy, New York)
3. S M Khopkar, Basic Concepts of Analytical Chemistry (New Age, International Publisher)
4. D A SKoog, F J Holler and T A Nieman, Principles of Instrumental Analysis (Thomson Asia Pvt. Ltd. Singapore)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/ Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>



<b>BSCH810</b>	<b>Medicinal Chemistry</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Graduation level Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

Study of the topics included in this course will enable the students to

1. Familiarize with the concept of Prodrug, drug and their classification.
2. build a basic knowledge of the theory of drug activity and structure activity relationship.
3. knowledge about isolation, structure elucidation and synthesis of some of the important drug

### Catalog Description

Medicinal chemistry is the discipline which involves intersection of synthetic organic chemistry, and pharmacology and various other biological specialties, where they are involved with design, chemical synthesis and development for market of pharmaceutical agents, or bio-active molecules (drugs). Medicines are required for treatment of different diseases and their action is dependent on their structure, stereochemistry, size and presence of different groups. This course provides an opportunity for understanding synthesis of several molecules possessing anti pyretic, sedative, antimalarial and cardiovascular drugs etc. along with their mode of action and metabolism. Theories regarding drug activity will be discussed.

### Course Content

#### UNIT I

##### Unit I: Introduction

Concept of drug; Lead compound and lead modification; Prodrugs and soft drugs; Structure-activity relationship (SAR); Quantitative structure-activity relationship (QSAR); Factors affecting bioactivity – resonance, inductive effect, isosterism, bio-isosterism, spatial considerations; Theories of drug activity – occupancy theory, rate theory, induced fit theory. Concept of drug receptors – elementary treatment of drug-receptor interactions; Physico-chemical parameters – lipophilicity, partition coefficient, electronic ionization constants, steric, Shelton and surface activity parameters and redox potentials; Factors affecting modes of drug administration, absorption, metabolism and elimination; Significance of drug metabolism in medicinal chemistry.

##### Unit II: Antibiotics

Cell wall biosynthesis, inhibitors of  $\beta$ -lactam rings, antibiotics inhibiting protein synthesis; Isolation, structure elucidation, synthesis, SAR and mode of action of penicillins; Synthesis of penicillin G, penicillin V, ampicillin, amoxicillin .

Isolation, structure elucidation, synthesis, SAR and mode of action of following antibiotics: streptomycin, tetracyclines and chloroamphanicol.

Antipyretic Analgesics: Classification and mode of action of antipyretic analgesics; Synthesis of paracetamol, chincophan, Novalgin and mefenamic acid.

Antimalarial drug: Nitrogen heterocycles as antimalarial agents, their classification and mode of action and synthesis of chloroquine, primaquine, and pyrimethamine.

### Unit III: Drug types - I

Antineoplastic drugs: Cancer chemotherapy, role of alkylating agents and antimetabolites in the treatment of cancer; Carcinolytic antibiotics and mitotic inhibitors; Synthesis of mechlorethamine, melphalan, 5-bromouracil and 6-mercaptopurine; Anticancer action of taxol.

Cardiovascular drug: Classification, synthesis and mode of action of quinidine, verapamil.

### Unit IV: Drug types – II

Hypnotics and sedatives: SAR and mode of action and synthesis of diazepam, oxazepam, barbiturates.

Local anaesthetics: Classification, SAR and mode of action and synthesis of procaine,  $\alpha$ -eucaine and  $\beta$ -eucaine, cinchocaine and quinisocaine.

Antiinfective drugs: Mode of action and synthesis of sulphonamides, norfloxacin, daspone, isoniazide.

### Textbooks:

1. M E Wolff (eds), Burger Medicinal Chemistry and Drug Discovery, Vol-1 (Wiley Interscience, New York)

### Reference Books:

1. L L Brunton, D K Blumenthal, N Dandan, R H Murri, B C Knollmann, Goodman and Gilman: The Pharmacological Basis of Therapeutics (McGraw-Hill, New York)
2. S S Pandeya and J R Dimmock, Introduction to Drug Design (New Age International(P) Ltd, New Delhi)
3. Graham and Patrick, Introduction to Medicinal Chemistry (Oxford University Press, Oxford)
4. T Nogrady and D F Weaver, Medicinal Chemistry (Oxford University Press, Oxford)

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**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

### Examination Scheme:

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH812</b>	<b>Nuclear Chemistry and Photochemistry</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

1. To be able to understand different kinds of radioactive decays.
2. To learn the difference between nuclear fission and fusion.
3. To estimate the age of any sample with the help of carbon dating.
4. To understand electron transfer and energy transfer reactions.

### Catalog Description

This course imparts the basic concepts of nuclear models and radioactivity. It enables the students to explain nuclear models and nuclear reactions of radioisotopes. The course of nuclear chemistry and photochemistry imparts in depth knowledge about techniques of nuclear chemistry and concepts of inorganic photochemistry.

### Course Content

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#### Unit I:

**8 Lectures**

**Nuclear Chemistry I:** Nuclear models – Shell model – Liquid drop model - Types of radioactive decay – Decay constant – Half-life period - Alpha decay – Theory of alpha decay - The tunnel effect - Beta decay– Types of beta decay - Electron capture - Dirac’s theory - Nuclear deexcitation – Artificial radioactivity. Nuclear reactions: Bathe’s notation.

#### Unit II:

**12 Lectures**

**Nuclear Reactions:** Types of nuclear reactions - Elastic and inelastic scattering – Cross section - Q value – Transuraniens - Photonuclear reaction - Radioactive capture - Evaporation and spallation – Buckshot hypothesis - Thermonuclear reactions – Nuclear fusion - Nuclear fission – Fission fragments - Mass and charge distribution - Fission energy.

**Unit III:****12 Lectures**

**Nuclear Chemistry II:** Breeder reactor – Counting techniques: G.M., Ionization and Proportional counter. Applications of radioisotopes – Esterification – Friedal Craft's reaction – Structural determination of  $\text{PCl}_5$  - Solubility of sparingly soluble substance – Isotope dilution analysis – Neutron activation analysis - Radiometric titration – Carbon dating – Thyroiditis - Assessing the volume of blood in a patient - Brain tumor location and bone fracture healing- Optimum use of fertilizers - Control of predatory insects - Prospecting of water and petroleum.

**Unit IV:****8 Lectures**

**Inorganic Photochemistry:** Principle of light absorption – physical and chemical processes – bimolecular reactions- Stern-Volmer relationship- Properties of d-d,  $\pi$ - $\pi$  and  $\pi$ -n\* energy states. Photochemical reactions of metal complexes – substitution- Admson's rules-rearrangement– isomerisation– racemisation– aquation and anation – redox reactions. Ruthenium polypyridyls – excited state properties – electron transfer and energy transfer quenching reactions –importance of solar energy conversion and storage – cleavage of water using  $\text{Ru}(\text{bpy})_3^{2+}$ , Cadmium sulphide colloidal particles and titanium dioxide semiconductor –  $[\text{Ru}(\text{edta})\text{H}_2\text{O}]$ - Catalysed ammonia production.

**Text Books**

1. J E Huheey, E A Keither and R L Keiter, Inorganic Chemistry (Harper Collins College Publisher, New York)
2. K K Rohatgi-Mukherjee, Fundamentals of Photochemistry (New Age International Publisher, New Delhi)

**Reference Books/Materials**

1. H J Arnika, Essential of Nuclear Chemistry (Wiley- Eastern Ltd., Delhi)
2. G Freindlander, J W Kennedy, E S Macias, and J M Miller, Nuclear and Radiochemistry (John Wiley and Sons, New York)
3. D F Shriver, P W Atkins and C H Langford, Inorganic Chemistry (ELBS, Oxford University Press)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH814</b>	<b>Bio-Inorganic and Supramolecular Chemistry</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Chemistry of toxic elements, human life and plant life				
<b>Co-requisites</b>	--				

### Course Objectives

1. To study the use of metals in life processes
2. To learn about various oxygen carrier system in living beings
3. To study the metal poisoning and drug action of inorganic complexes compounds.
4. To understand about the biogeochemistry of trace metals in plants

### Catalog Description

This course imparts the basic knowledge of metal and elements important in life process of human and plants including their role in complexes formation and enzyme activators. This course helps them to know the structure of various enzymes and their mechanism. The course also introduces the toxic metals, their toxicity level and treatment methods with chelate and complexes. This also provides brief idea about the role of trace elements as micronutrients in humans and plants.

### Course Content

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#### UNIT I: Metals in Life Processes

**12 Lectures**

Na-K-charge carriers & osmotic pressure, relation to sensitivity of nerves and control on muscles, Mg-Ca complexes with nucleic acid, nerve impulse transmission, trigger reaction, Mn, Fe, Co, Cu, Mo, ferridoxins, Zn-super acid catalysis.

#### UNIT II:

**10 Lectures**

##### Oxygen Carrier Systems-

Structure and mechanism of hemoglobin, vitamin B<sub>12</sub>, B<sub>12</sub> co-enzyme myoglobin, synthesis of oxygen carriers.

**Photosynthesis-** Complexes of prophyries porphyrins ring complexes, redox mechanism.

**UNIT III:****16 Lectures****Nitrogen Fixation-**

Nitrogen in biosphere, nitrogen cycle, nitrification role of microorganisms, nitrogen fixation in soils.

**Metal poisoning and drug action of Inorganic complexes compounds-**

Metal poisoning, treatment by using chelating agent, mercury, lead & cadmium poisoning & treatment. Platinum complexes in treatment of cancer, metal deficiency and use of metal chelates.

**UNIT-IV:****12 Lectures****Trace Metals in Plant Life-**

Micronutrients in soil, role of micronutrients in plant life

**Biogeochemistry-**

Biodegradation of minerals bacteria leaching and its applications.

**Text Books**

1. Williams, an Introduction to Bioinorganic Chemistry (C.C. Thomas Spring III)
2. Eichhorn, Inorganic Biochemistry : Vol I, 2 (Elsevier)

**Reference Books/Materials**

1. Ochiai, Bioinorganic Chemistry (Allyn & Bacon Burton)
2. Wallace, Decade on synthetic chelating agent in Inorganic plant nutrition (Wallace)
3. Zagic, Microbial Biogeochemistry (Academic press)
4. Ahuja, Chemical Analysis of the Environment (Plenum press)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH816</b>	<b>CHEMISTRY OF LIFE PROCESSES</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of biomolecules and metabolism				
<b>Co-requisites</b>	--				

### Course Objectives

1. Appreciate chemistry and stereochemistry of carbohydrates.
2. Understand Characteristics and mechanism of enzymes.
3. Acquire knowledge about structure and functions of amino acid, protein and peptides.

### Catalog Description

This course composed of Occurrence, isolation, biological significance (brief idea) and synthesis of the following Vitamins; Structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars; Disaccharides and polysaccharides.; Carbohydrate metabolism; Structures and function of triglycerides, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins; Lipoproteins composition , function and role in arthrosclerosis; Chemical and enzymatic hydrolysis of proteins to peptides; Amino acid sequencing and details of Nucleic acid with An overview of replication of DNA, transcription, translation and genetic code.

### Course Content

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#### Unit I: Vitamins and Enzymes

**10 Lectures**

Occurrence, isolation, biological significance (brief idea) and synthesis of the following vitamins : Vitamin A, E, K, Thiamine, Riboflavin, Pyridoxine, Niacin, Pantothenic acid and ascorbic acid.

Nomenclature; Characteristics (mention of ribozymes); Classification; Active site; Mechanism of enzyme action; Derivation of Michealis Mentis Equation; Stereospecificity of enzymes, coenzymes and cofactors; Enzyme inhibitors; Introduction to biocatalysis: Importance in Green Chemistry and chemical industry.

#### Unit II: Carbohydrates

**10 Lectures**

Conformation of monosaccharides; Structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars; Disaccharides and polysaccharides. Structural polysaccharides: cellulose and chitin; Storage polysaccharides: Starch and glycogen. Structure and biological functions of glucosaminoglycans or mucopolysaccharides; Carbohydrates of glycoprotines and glycolipides; Role of sugars in biological recognition; Carbohydrate metabolism: Kreb's cycle; Glycolysis, glycogenesis and glycogenolysis; Pentose phosphate pathway.

**Unit III: Lipids****8 Lectures**

Fatty acids; Essential fatty acids; Structures and function of triglycerides, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins; Lipoproteins composition, function and role in atherosclerosis; Properties of lipid aggregates: micelles, bilayers, liposomes and their possible biological functions; Biological membranes: Fluid mosaic model of membrane structure; Lipid metabolism: Oxidation of fatty acids.

**Unit IV:****12 Lectures**

**Amino acids, peptides and proteins:** Chemical and enzymatic hydrolysis of proteins to peptides; Amino acid sequencing; Secondary structure of protein; Forces responsible for holding of secondary structures; helix and sheets; Super secondary structure; Triple helix structure of collagen; Tertiary structure of protein- folding and domain structure; Quaternary structure. Amino acid metabolism: Degradation and biosynthesis of amino acids; Sequence determination: chemical/ enzymatic/ mass spectral, racemization/ detection; Chemistry of oxytocin and tryptophan releasing hormone (TRH).

**Nucleic acids:** Purine and pyrimidine of nucleic acids; Base pairing via H – bonding; Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA); Double helix model of DNA and forces responsible for holding it; Chemical and enzymatic hydrolysis of nucleic acids; The chemical basis for heredity; An overview of replication of DNA, transcription, translation and genetic code; Chemical synthesis of mono and poly nucleosides.

**Textbooks:**

1. U. Satyanarayan, Biochemistry (Elsevier India Pvt. Ltd.)

**Reference Books:**

1. J M Berg, J L Tymoczko and L Stryer, Biochemistry (W.H. Freeman and Co. New York, USA)
2. D L Nelson, M M Cox, and A L Lehninger, Principles of Biochemistry (W.H. Freeman and Co., New York)
3. E E Conn and P K Stumpf, Outlines of Biochemistry (John Wiley)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50



<b>BSCH818</b>	<b>Nanochemistry</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

1. To be able to understand classification of nanoparticles based on size.
2. To learn the experimental methods for synthesising nanomaterials.
3. To understand characterisation techniques that can be employed to study nano dimension.
4. To develop a comprehensive knowledge about applications of nanomaterials in various fields of science.

### Catalog Description

This course imparts the basic concepts of nanotechnology. It enables the students to understand the idea of synthesis and structural aspects of different types of nanomaterials. The course of nanochemistry will impart the knowledge about different characterisation techniques for nanomaterials. The course also introduces the different applications of nanoparticles in various fields.

### Course Content

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#### Unit I:

**8 Lectures**

Nanoscale building blocks and its applications Zero dimensional nano materials, One dimensional nano materials, Two dimensional nano materials General introduction to nanomaterials and emergence of nanotechnology; Moore's law; synthesis of nanoparticles of gold, rhodium, palladium, platinum and silver; Synthesis of nanoparticle semiconductors, nanowires and nanorods.

#### Unit II:

**12 Lectures**

Techniques of synthesis: electroplating and electro-phoretic deposition, conversion through chemical reactions and lithography; Thin films: Chemical vapor deposition and Atomic layer deposition techniques;

**Unit III:****12 Lectures**

Carbon fullerenes, Nanotubes, Nanobiotechnology, nanosensors, nanomedicines, etc., Implications of nanotechnology, Experimental methods for preparation of nanomaterials: Chemical and Physical, Characterization techniques for nanomaterials, Size dependent properties of nanoparticles: optical properties, M.P., surface to volume ratio.

**Unit IV:****8 Lectures**

Synthesis of Biodegradable and non- biodegradable nanoparticle and their uses in different fields. Future fantasy and nanotechnology. Application of nanotechnology in different fields. Nanotechnology in drug delivery applications.

**Textbooks**

1. G Zhong Cao, Nanostructures and Nanomaterials: Synthesis, Properties and Applications (Imperial College Press).
2. M Ratner & D Ratner, Nanotechnology: A Gentle Introduction to the Next Big Idea (Pearson Education)

**Reference Books/Materials**

1. G Schmid, Nanotechnology, Volume 1: Principles and Fundamentals (Wiley Sons).
2. T Pradeep, Nano the Essentials: Understanding Nanoscience and Nanotechnology (Mc Graw Hill.)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/ Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH820</b>	<b>Group Theory and Spectroscopy</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of symmetry elements				
<b>Co-requisites</b>	--				

### Course Objectives

1. To give the introduction of symmetry and group theory and its role in structure, bonding and reactivity.
2. To provide scientific understanding of spectroscopy and detail interpretation of results.
3. Apply basic concepts to predict the appearance of microwave, vibrational and rotational spectra of organic and inorganic molecules.
4. Explain the general principles and describe the instrumentation of rotational and vibrational spectroscopies.

### Catalog Description

The main focus of this course is to provide the students with deeper understanding on spectroscopy. It also emphasis on how molecular symmetry and group theory are usefully related to spectroscopy. In addition, this course also aims to strengthen the knowledge of the students in some fundamental concepts of spectroscopic transition of molecules by combining both spectroscopy and group theory together.

### Course Content

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#### Unit I:

**10 Lectures**

Symmetry elements and symmetry operation, point groups and their classification with examples, sub groups. General methods of assigning point groups to a molecules like water ( $C_{2v}$ ), ammonia ( $C_{3v}$ ), phosphorous ( $D_{3h}$ ) and Xenon tetrafluoride ( $D_{4h}$ ).

#### Unit II:

**8 Lectures**

Application of group theory to chemical bonding, hybrid orbitals for  $\sigma$  bonding in different geometries and hybrid orbitals for  $\pi$  bonding, symmetric of molecular orbitals in  $BF_3$ ,  $C_2H_4$  and  $B_2H_6$ .

#### Unit III:

**6 Lectures**

Rotational and vibrational spectroscopy: Introduction, fundamental principle and applications

#### Unit IV:

**10 Lectures**

Raman Spectroscopy- Classical and quantum theories of Raman effect, pure rotational - vibrational and vibrational - rotational Raman spectra, Selection rules, mutual exclusion principle, resonance Raman Spectroscopy.

**Textbooks:**

1. R Chang, Basic Principles of Spectroscopy (McGraw- Hill, New York, N. Y.)
2. G M Barroe, Introduction to Molecular Spectroscopy (McGraw- Hill)

**Reference Books:**

1. F A Cotton, Chemical Applications of Group Theory (Wiley Interscience, N. Y.)
2. D M Bishop, Group Theory and Chemistry (Clarendon Press Oxford, U. K.)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination  
Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>

<b>BSCH822</b>	<b>NATURAL PRODUCT CHEMISTRY</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of reaction mechanism				
<b>Co-requisites</b>	--				

### Course Objectives

Study of the topics included in this course will enable the students to

1. build a basic knowledge of the general classification of natural products and their isolation.
2. appreciate the developments regarding terpenoids and vitamins.
3. understand the structure, synthesis and biosynthesis of common alkaloids.
4. learn about isolation and study of important constituents of essential oils and aromatics.

### Catalog Description

This course imparts the knowledge of natural products availability, properties and biosynthesis. This course provides information regarding variety of Terpenes, Alkaloids and Steroids. The value of essential oils in life is an interesting part of this syllabus. It relates to essential oils isolations and applications.

### Course Content

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#### Unit I: Natural products and their biosynthetic pathways

**8 Lectures**

General classification of natural products, their isolation and characterisation and biosynthesis of common plant products; Biosynthesis pathways for natural products using co-enzymes and enzymes; Synthesis of selected natural products based on genetic classification – fatty acid derivatives and related compounds, general biogenesis and synthesis of cis-jasmone, methyljasmonate, prostaglandins, exaltone and muscone.

#### Unit II: Terpenoids

**12 Lectures**

General biosyntheses of mono- and sesquiterpenes, diterpenes, and higher terpenes, trans-chrysanthenic acid, cyclo-pentato monoterpene lactones; Synthesis of  $\alpha$ -vetinone and total synthesis of  $\beta$ -eudesmol; Synthesis of hirsutene, abietic acid, cis juvenile hormone; trans annular cyclisation of caryophyllene, synthesis of caryophyllene and isocaryophyllene; Rearrangements of santonic acid and thujospene; Synthesis and rearrangement of longifolene.

**Unit III: Alkaloids and Steroids****12 Lectures**

Structure, synthesis and biosynthesis of common alkaloids: Strychnine, lysergic acid, reserpine, nicotine, morphine, emitine.

Biosynthesis of steroids; Nomenclature of steroids and synthesis of squalene, lanosterol and caretonoids; Synthesis of equeulins; Estrogens and total synthesis of non-aromatic steroids (progesterones); Corticosteroids; Degradation of diosgenin to progesterone and its synthesis.

**Unit IV: Essential oils and aromatics:****8 Lectures**

Isolation and study of important constituents of lemon grass oil, citronella oil, cinnamon oil, palmarosa oil, rosemary oil, patchouli oil, peppermint oil, turpentine oil, clove oil, sandalwood oil, lavender oil, rose oil; Essential oils of turmeric and ginger; Oleoresins of pepper, chilly, ginger and turmeric; Use of essential oil in medicine - Aromatherapy.

**Textbooks:**

1. S V Bhat, B A Nagasampagi, S Minakshi, Natural products: Chemistry and Applications (Alpha Science International Ltd, Oxford)
2. I L Finar, Organic Chemistry, Volume 2: Stereochemistry and the Chemistry Natural Products (Dorling kinderslay (India) Pvt Ltd, New Delhi)

**Reference Books:**

1. K Nakanashi, Natural Products Chemistry, Vols. I and II (Academic Press, New York and London)
2. E Guenther, The constituent of essential oils (Krieger Publishing Company, New York)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination****Examination Scheme:**

Components	Quiz/Assignment	Attendance	Mid Term Exam	Presentation/Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

<b>BSCH824</b>	<b>Solid State Chemistry</b>	L	T	P	C
<b>Version 1.0</b>		4	0	0	4
<b>Pre-requisites/Exposure</b>	Basics of Physical Chemistry				
<b>Co-requisites</b>	--				

### Course Objectives

1. To be able to explain the peculiar properties of crystalline state, and the defects present in them.
2. To learn about electronic structure of metals and the concept of bands.
3. To understand the theory behind optical and electron microscopy techniques which are used to characterise solids.
4. To understand the kinetics of solid state reactions.

### Catalog Description

This course imparts the basic concepts of solid state chemistry and crystalline structure. It enables the students to study the solid state reactions and their experimental procedures. The course discusses the electronic and optical properties of solids. It also discusses about the presence of various defects in crystals and their thermodynamics.

### Course Content

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#### Unit I:

**8 Lectures**

Solid state Reactions

General principles, experimental procedure, co-precipitation as a precursor to solid reactions, kinetics of solid state reactions.

#### Unit II:

**12 Lectures**

Crystal Defects and Non-stoichiometry

Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formations. Colour centres, non-stoichiometry and defects.

**Unit III:****12 Lectures**

Electronic properties and Band Theory

Metals, insulators and semiconductors, electronic structure of solids, band theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors. Doping semiconductors, superconductors.

**Unit IV:****8 Lectures**

Optical properties

Application of optical and electron microscopy. Magnetic properties-Classification of materials: Effect of temperature. Calculation of magnetic moment, mechanism of ferro and anti-ferromagnetic ordering super exchange.

**Textbooks**

1. H V Keer, Principles of Solid state (Wiley Eastern)
2. L E Smart, E A Moore, Solid State Chemistry: An Introduction (World Scientific Publishing)

**Reference Books/Materials**

1. A. R. West, Solid state Chemistry and its Applications (Peenum)
2. D K Chakrabarty, Solid state Chemistry (New Wiley Eastern)

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/ Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>



<b>BSCH858</b>	<b>Dissertation</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		0	0	0	8
<b>Pre-requisites/Exposure</b>	Practical exposure				
<b>Co-requisites</b>	--				

### Course Objectives

1. To learn how to carry out literature survey
2. To be associated with an area of research/research project and contribute towards domain knowledge.
3. To learn the art of technical report writing
4. To learn the art of verbal communication with the help of modern presentation techniques.

### Catalog Description

1. Students will be divided among faculty members of the Department for the supervision of the research work.
2. In the first week of Semester IV, each faculty member will assign a suitable research topic to the students from the selected topics in the areas of chemical sciences.
3. The student will work on the assigned research topic during semesters IV in regular consultation with his/her assigned faculty.
4. The student will write a dissertation based on the research work carried out during Semesters IV and prepare two copies to be submitted to the office of the Head of the Department duly signed by the student and the supervisor at the end of IV semester or a date decided by the HOD of the department.
5. Before preparing power point presentation and submission of dissertation, each student has to deliver presentation on his/ her research project work on a date fixed by HOD, necessary suggestions has to be incorporated in the final draft of dissertation.
6. The student will make a power point presentation based on the work carried out and mentioned in the dissertation to the board of examiners appointed by the University.

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

**Examination Scheme:**

<b>Components</b>	<b>Quiz/Assignment</b>	<b>Attendance</b>	<b>Mid Term Exam</b>	<b>Presentation/ Assignment/ etc.</b>	<b>End Term Exam</b>
<b>Weightage (%)</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>50</b>