SEMESTER-V

Program: B.Sc. (Sem-V)	**Type:** Theory
Subject: DSC-9-Organic Chemistry-3: Study of Natural & Synthetic Product in Organic Chemistry	
Credit: 04 (T) + 02 (P)	**Total learning hours:** 60
Course description: This course provide basic information regarding natural organic products like carbohydrate, lipids, amino acids and protein, alkaloids, steroids and enzymes.	
Student learning outcome: Student will learn following: • Carbohydrates, Lipids, Amino acid, Protein and Peptides • Nucleic acid, Alkaloids and Terpenes • Enzymes, Vitamins and hormones • Steroids	

Unit-1 Carbohydrates 05Hrs)

1.1 Occurrence, classification and their biological importance
1.2 Monosaccharides – constitution and configuration of glucose and fructose
1.3 Mutarotation
1.4 Haworth Projection and conformational structure
1.5 Killiani – Fischer synthesis and Ruff degradation
1.6 Disaccharides
1.7 Polysaccharides

Unit-2 Lipids (05 Hrs)

2.1 Introduction
2.2 Classification
2.3 Oils and fats
2.4 Common fatty acids – Omega and trans fatty acid
2.5 Hydrogenation
2.6 Saponification value, acid value
2.7 Iodine number
2.8 Biological importance of triglycerides, phospholipids and glycolipids

Unit-3 Amino acid, Protein and Peptides (08 Hrs)

3.1 Classification
3.2 Zwitterion structure and isoelctric point
3.3 Study of primary, secondary, tertiary and quaternary structure of proteins
3.4 Determination of primary structure of peptides
3.5 Synthesis of peptide using N-protecting, C-Protecting and C- activating group
3.6 Merrifield Solid phase synthesis

Unit- 4 Nucleic Acid: (08 Hrs)

4.1 Component of Nucleic acid – Adenine, Guanine, Thymine and Cytosine
4.2 Nomenclature of nucleosides and nucleotides
4.3 Structure of polynucleotides
4.4 Structure of DNA-Watson-Crick model
4.5 Types of RNA, Genetic code
4.6 Biological role of DNA and RNA – Replication, Transcription and Translation

Unit-5 Alkaloids and Terpenes: (10 Hrs)

- **5.1** Natural occurrence
- **5.2** General structural feature, isolation and their physiological action
- **5.3** Hoffmann's exhaustive methylation
- **5.4** Emde's modification
- **5.5** Structure elucidation and synthesis of Hygrine and Nicotine
- **5.6** Medicinal importance of Nicotine, Hygrine, Quinine, Morphene, Cocaine and Reserpine
- **5.7** Occurrence and classification of terpenes
- **5.8** Isoprene rule
- **5.9** Elucidation of structure and synthesis of Citral, Neral and α-terpineol

Unit-6 Enzymes (08 Hrs)

- **6.1** Introduction, classification and characteristic of enzymes
- **6.2** Salient features of active site
- **6.3** Mechanism of enzyme action – e.x trypsin
- **6.4** Factors affecting enzyme actions
- **6.5** Coenzyme and cofactors and their role in biological reaction
- **6.6** Specificity of enzyme action – Stereospecificity
- **6.7** Enzyme inhibiters and their importance
- **6.8** Phenomena of inhibition – competitive, uncompetitive and non-competitive inhibition – allosteric inhibition

Unit-7 Vitamins and hormones (08 Hrs)

- **7.1** Introduction of vitamin
- **7.2** Source of Vitamin
- **7.3** Classifications of Vitamin – Water Soluble, Fat Soluble
- **7.4** Structure and Action of Vitamins in human body
- **7.5** Hormones Introduction and overview
- **7.6** Biosynthesis of hormones
- **7.7** Hormone receptors
- **7.8** Mechanism of hormonal action

Unit-8 Steroids (08 Hrs)

- **8.1** Introduction
- **8.2** Nomenclature of steroids
- **8.3** Cholesterol
- **8.4** Colour Reactions
- **8.5** Some reactions of steroids
- **8.6** Stigmasterol
- **8.7** β-Sitotsterol
- **8.8** Bile Acids
- **8.9** Ergosterol , Diosgenin, Solasodine, Hecogenin

Reference Book:

1. Organic Chemistry, Volume-1,2, I.L.Finar, 6 th Edn., 2002, , Pearson
2. Organic Chemistry, Seventh Edition, By R.T.Morrison, R.N.Boyd, S.K. Bhattacharjee 2010, Pearson
3. Advance Organic Chemistry, Arun Bahl and B S Bahl, 2012, S.Chand
4. Organic Chemistry, W.H. Perkin and F. S. Kipping, 2012, Nabu Press
5. Hormones , Anthony W. Norman and Gerald Litwack , 2nd Edn., 1997, Academic press

Program: B.Sc. (Sem-V)	**Type:** Theory
Subject: DSC-10- Physical Chemistry-IV: Surface Chemistry & Colloid Science	
Credit: 04 (T) + 02 (P)	**Total learning hours:** 60
Course description: This Course Paper proposes to teach about: Distribution law and its applications, catalysis, adsorption, adsorption isotherms, colloids, emulsions, gels, associated colloids, sols- characteristics, types, theories and applications.	
Student learning outcome: After completing this course, the students will be able to learn: Explanation- Modifications and limitations of distribution law, determination of equilibrium constant, characteristics-properties, types and theories of catalysis, adsorption, colloids, emulsions, gels, associated colloids, sols, mechanisms of adsorption isotherms and applications of above all topics in various fields.	

Unit 1: Distribution Law: **(04Hrs)**

- **1.1** Nernst distribution law
- **1.2** Solubility and distribution law
- **1.3** Explanation and limitations of distribution law
- **1.4** Modifications in distribution law
- **1.5** Henry's law
- **1.6** Determination of equilibrium constant from distribution co-efficient
- **1.7** Extraction and multiple extractions
- **1.8** Applications of distribution law
- **1.9** Numerical

Unit 2: Catalysis **(04 Hrs)**

- **2.1** Types of catalysis
- **2.2** Characteristics of catalytic reactions
- **2.3** Promoters
- **2.4** Catalytic poisoning

Unit 3 Types of Catalysis **(08 Hrs)**

- **3.1** Autocatalysis
- **3.2** Negative catalysis
- **3.3** Acid-base catalysis
- **3.4** Enzyme catalysis

Unit 4: Theories of Catalysis **(12 Hrs)**

- **4.1** Intermediate compound formation theory
- **4.2** Adsorption theory
- **4.3** Hydrogenation of Ethylene in presence of Nickle
- **4.4** Activation energy and catalysis

Unit 5: Adsorption **(04 Hrs)**

- **5.**1 Mechanism of adsorption
- 5.**2** Types of adsorption

5.3 Characteristics of adsorption,
5.4 Adsorption in gases by soilds
5.5 Physical adsorption and chemical adsorption

Unit 6: Adsorption Isotherm **(12 Hrs)**

6.1 Langmuir
6.2 Freundlich
6.3 Adsorption of solutes from solutions
6.4 Applications of adsorption
6.5 Ion exchange adsorption
6.6 Applications of ion exchange adsorption

Unit 7: Colloids **(08 Hrs)**

7.1 Types of colloidal systems
7.2 Lyophilic and Lyophobic colloids
7.3 Characteristics and comparision of Lyophilic and Lyophobic colloids
7.4 Preparation and purification of Lyophilic and Lyophobic colloids
7.5 Origin of charge on sol particles and it's stability
7.6 Types, preparation and properties of emulsions
7.7 Types and properties of gels
7.8 Associated colloids: A soap micelle – Cleansing action of soap and detergents

Unit 8:Properties of Sols: **(08 Hrs)**

8.1 Optical properties - Tyndal effect
8.2 Kinetic properties - Brownian movement
8.3 Electrical properties - Electrical double layer
8.4 Flocculation values and gold numbers
8.5 Origin of charge on sol particles
8.6 Stability of sols
8.7 Applications of colloids

Reference Books:

1. Essentials of Physical Chemistry; 1st Revised Edition, Arun Bahl, B.S. Bahi, G.D. Tuli; 2008, Reprint 2016, S. Chand and Company Limited
2. Physical Chemistry, 10th Edition, Atkins P. W. and De Paula J., 2014, Oxford University Press
3. Physical Chemistry, 4th Edition, Castellan, G. W., 2004, Narosa Publishers
4. Physical Chemistry; 3rd Edition, Engel, T. & Reid, P., 2012, Prentice-Hall
5. Chemistry concepts and applications, Zundhal, S.S., 2011, Cengage India
6. Physical Chemistry, Ball D. W., 2012, Cengage India
7. Physical Chemistry, 3rd Edition, Mortimer, R. G., 2009, Elsevier
8. Physical Chemistry, 6th Edition, Levine, I. N., 2011, Tata McGraw-Hill
9. Physical Chemistry, 2nd Edition, Metz, C. R., 2009, Tata McGraw-Hill
10. A Text Book of Physical Chemistry; 5th Edition, K.K. Sharma, L.K. Sharma, 2012, Vikas Publishing House.

Program: B.Sc. (Sem-V)	**Type:** Theory
Subject: SEC-3-Instrumentation and Techniques	
Credit: 04 (T) + 02 (P)	**Total learning hours:** 60

Course description:

This course is concerned with the theory and practice of instrumental methods for the separation, identification and quantitative analysis.

Student learning outcome:

Upon completion of this course, students will:

- Integrate a fundamental understanding of the underlining principles.
- Use key instrumental techniques for separation and analysis.
- Distinguish between qualitative and quantitative measurements and be able to effectively compare and critically select methods for analyses.

Unit-1 Introduction to Instrumental Methods (04 Hrs)

1.1 Classification of analytical methods
1.2 Types of instrumental techniques
1.3 Basic functions of instrumentation
1.4 Instruments for analysis
1.5 Factors affecting the choice of technique

Unit-2 Potentiometry (08 Hrs)

2.1 General principle
2.2 Reference electrode: Calomel electrode and silver/silver chloride electrode
2.3 Membrane indicator electrode
2.3.1 Types of membrane
2.3.2 Glass electrode for pH measurement
2.3.3 Other ion selective electrodes
2.4 Bio-catalytic membrane electrode

Unit-3 Optical Methods of Analysis (10 Hrs)

3.1 Origin of spectra, interaction of radiation with matter, Beer-Lambert's law
3.2 UV-Visible Spectrometry: Basic principle, instrumentation (single and double beam instrument), application
3.3 Infrared Spectrometry: Basic principle, instrumentation (single and double beam instrument), sampling technique, application
3.4 Atomic absorption spectrometry: Basic principles of instrumentation, choice of flame and burner designs, techniques of atomization and sample introduction

Unit-4 Thermo-Analytical Instruments (06 Hrs)

4.1 Theory of thermogravimetry (TG)
4.2 Basic principle of instrumentation

4.3 Techniques for quantitative estimation of Ca and Mg from mixture
4.4 Applications and limitations

Unit-5 Chromatography: I (09 Hrs)

5.1 Classification
5.2 Principle and efficiency of the technique
5.3 Paper Chromatography: Principles, procedures, developments of chromatogram - ascending, descending and radial, applications
5.4 Thin layer Chromatography (TLC): Advantages, principles, adsorbents and solvents preparation of plates development of the chromatogram, spot detection, applications

Unit-6 Chromatography: II (10 Hrs)

6.1 Gas chromatography: Principles, stationary and mobile phases, column, detectors (TCD, ECD, FID), application and limitation
6.2 HPLC: Basic principle, instrumentation, detectors, application
6.3 Ion exchange chromatography
6.4 Gel filtration chromatography

Unit-7 Electrophoresis (07 Hrs)

7.1 Introduction
7.2 Types of electrophoresis
7.3 Principle
7.4 Application

Unit-8 Radiochemical Instruments (06 Hrs)

8.1 Fundamentals of radiochemical methods
8.2 Measurement of alpha particles
8.3 Measurement of beta particles
8.4 Measurement of gamma radiation
8.5 Isotope dilution method: Principle and application

Reference Books:

1. Basic Concepts of Analytical Chemistry, S.M. Khopkar,2008, New age international Publication
2. Elementary organic spectroscopy, Y.R. Sharma, 2013, S. Chand publication
3. Instrumental Methods of Analysis, Willard, H.H, 7th Edn., CBS
4. Principles of Instrumental Analysis, Skoog, Holler F.J. Stanley R. Crouch, 2016, Cengage Learning
5. Quantitative analytical chemistry, James S. Fritz George H. Schenk, 1974, Allyn and Bacon
6. Instrumental methods of Chemical analysis by Gurdeep R.Chatwal, 2014, Himalaya Publication House

Program: B.Sc. (Sem-V)	**Type:** Theory
Subject: DSE-5-Bioinformatics and Chemoinformatics	
Credit: 02	**Total learning hours:** 30

Course description: The objectives of this course are to provide students with the theory and practical experience of the use of common Bioinformatics tools which facilitate investigation of molecular biology and evolution-related concepts.
This course for chemistry, biochemistry and bioinformatics students introduces the small-molecule-ligand-oriented in silico physical chemistry aspects of rational drug design.
Topics include Introduction to subject, information regarding basic database and application of cheminformatics.

Student learning outcome:

- Able to gain basic idea of Computer and Bioinformatics
- Able to understand what is Database and how it is managed?
- Can gain knowledge of NCBI and other Bioinformatics concepts.
- Able to understand aim of Bioinformatics, its scope and use for biotechnology research
- Able to Describe the principles of cheminformatics
- Able investigate chemicals and materials that are not practical for laboratory analysis
- Able to practise computer assisted structure elucidations

Unit-1 Introduction to Computer & Bioinformatics (04 Hrs)

1.1 MS-WORD, EXCEL, Microsoft PowerPoint, Adobe Photoshop
1.2 Introduction & History of Bioinformatics
1.3 Area and Scope of Bioinformatics
1.4 Biological databases, Primary & Secondary Database, DNA and Protein Structure \ and sequence Database, Metabolic Pathway Database

Unit-2 Bioinformatics Tools (04 Hrs)

2.1 Sequence alignment: Pairwise alignment techniques Global alignment, Local Alignment
2.2 Pairwise alignment techniques- continued, Significance of alignment- Z-score, P-score, E-value
2.3 Different types of BLAST and FASTA
2**.4** Multiple sequence Alignment-Dynamic Programing Sequence alignment, ClUSTAL W, HMM

UNIT-3 Bioinformatics Software & Program (04 Hrs)

3.1 Concept of dendrograms and its interpretation, Phylogenetic analysis -Maximum Parsimony and UPGMA methods
3.2 Phylogenetic trees: Rooted and unrooted trees
3.3 Phylogeny programs: PHYLIP, PAUP, MEGA.
3.4 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol)

Unit-4 Organization of Bioinformatics in India (03 Hrs)

4.1 BTIS
4**.2** Protein structure prediction server, Conformational epitope prediction server
4.3 Genomics and Proteomics server
4.4 Indian IT Companies involved in Bioinformatics Initiatives

Unit: 5 Introduction to Cheminformatics **(04 Hrs)**

- **5.1** History and evolution of cheminformatics
- **5.2** Use of cheminformatics
- **5.3** Prospects of cheminformatics
- **5.4** Molecular modelling and structure elucidation

Unit: 6 Chemical Databases **(04 Hrs)**

- **6.1** CHEMDB
- **6.2** KEGG LIGAND
- **6.3** CSD
- **6.4** CAS REGISTRY
- **6.5** BIOMETA DB
- **6.6** National Cancer Institute Database(NCI), PubChem, chEMBL, DrugBank, etc.

Unit-7 Molecular Drawing and Interactive Visualization **(03 Hrs)**

- **7.1** ChemDraw
- **7.2** MarvinSketch
- **7.3** ORTEP
- **7.4** Chimera

Unit-8 Application of Cheminformatics **(04 Hrs)**

- **8.1** Prediction of properties of compounds
- **8.2** Linear Free Energy Relations;
- **8.3** Quantitative Structure-Property Relations
- **8.4** Model Building
- **8.5** Structure-Spectra correlations

Reference books:

1. Bioinformatics: Sequence and genome analysis, Mount, D. W., 2001, Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
2. Introduction to bioinformatics, Attwood TK, Parry-Smith DJ. Essex, 1999, GB: Pearson Education
3. Bioinformatics: Principles and Applications, Ghosh Z. and Bibekanand M., 2008, Oxford University Press
4. An introduction to Chemoinformatics, Andrew R. Leach & Valerie, J. Gillet, 2007, Springer: The Netherlands.
5. Chemoinformatics: A text-book, Gasteiger, J. & Engel, T., 2003, Wiley-VCH.
6. QSAR & Molecular Modeling, Gupta, S. P., 2011, New Delhi: Anamaya Pub.
7. Molecular Modelling for Beginners, Alan Hinchliffe, 2003, John-Wiley

Chemistry Lab-Semester-V

1. To determine the molecular condition of Benzoic acid in its solution in Kerosene by the method of partition coefficient
2. Verify the Langmuir isotherms for adsorption of acetic acid on activated charcoal
3. Verify the Freundlich isotherms for adsorption of metal on natural adsorbent
4. Determination of pH of soil/aerated drinks/fruit juices/shampoos/soaps
5. Verification of Lambert-Beer's law and determination of concentration of a coloured species ($CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$)
6. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography/Separation of green leaf pigments/o- and p-nitrophenol/ Sudan yellow and Sudan Red using TLC
7. Analysis of pre-recorded IR spectroscopic data of organic compounds
8. Organic Estimation (Any two)
   1) Vitamin-C
   2) Gycine
   3) Aniline/Phenol
9. Organic Preparation(Single Step):
   1) Preparation of m-dintrobenzene from nitrobenzene.
   2) Preparation of benzoic acid from benzaldehyde.
   3) Preparation of p-aminobenzoic acid from p-nitrobenzoic acid.

Reference Books:

1. Advanced Physical Chemistry, J.B. Yadav, 14th Edition, 1995, Goel Publishing House.
2. Experiments in Physical Chemistry 8th Ed.; Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. McGraw-Hill: New York (2003).
3. A Text Book on Chemistry Practical; 1st Edition, Bidhan Chandra Ray, Satyanarayan Das, Reprint 2017, NCBA.
4. Vogel, A.I. Quantitative Organic Analysis, Part 3, ,2012, Pearson