

**BS-ADP (Chemistry) Programme (5<sup>th</sup> to 8<sup>th</sup> Semester)**

BS-adp (Chemistry) Programme after Associate Degree is held on semester system comprising of four (04) semesters. The Scheme of study, Syllabi and Courses of Reading for BS 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> semesters are given below:

**BS-ADP5<sup>th</sup> Semester:**

Title	Credit hrs	Code
Translation of Holy Quran	0	HQ-005
Physical Chemistry-I (Electrochemistry)	2	Chem-301
Physical Chemistry-II (Quantum Chemistry)	2	Chem-302
Physical Chemistry Lab	1	Chem-303
Inorganic Chemistry-I (Pi-Acceptor Ligands)	2	Chem-304
Inorganic Chemistry-II (Chemical Bonding Theories)	2	Chem-305
Inorganic Chemistry Lab	1	Chem-306
Organic Chemistry-I (Fundamental Concepts)	2	Chem-307
Organic Chemistry-II (Named Reactions)	2	Chem-308
Organic Chemistry Lab	1	Chem-309

**One of the following three optional**

Analytical Chemistry-I (Analytical Data Handling)	2	Chem-310
Analytical Chemistry-II (Chromatography)	2	Chem-311
Analytical Chemistry Lab	1	Chem-312
Or		
Applied Chemistry-I (Unit Operations & Chemicals)	2	Chem-313
Applied Chemistry-II (Allied Chemical Industries)	2	Chem-314
Applied Chemistry Lab	1	Chem-315
Or		
Bio Chemistry-I (Carbohydrates)	2	Chem-316
Bio Chemistry-II (General Biochemistry)	2	Chem-317
Bio Chemistry Lab	1	Chem-318

**Total Credit Hours: 20**

(2 credits theory and 1 credit practical)

**BS-ADP 6<sup>th</sup> Semester:**

	Credit hrs	Code
Translation of Holy Quran	1	HQ-006
Physical Chemistry-I (Chemical Kinetics)	2	Chem-319
Physical Chemistry-II (Thermodynamics)	2	Chem-320
Physical Chemistry Lab	1	Chem-321
Inorganic Chemistry-I (Coordination Chemistry)	2	Chem-322
Inorganic Chemistry-II (f-block elements)	2	Chem-323
Inorganic Chemistry Lab	1	Chem-324
Organic Chemistry-I (Reaction Mechanisms-I)	2	Chem-325
Organic Chemistry-II (Spectroscopy)	2	Chem-326
Organic Chemistry Lab	1	Chem-327

**BS (Chemistry)**

Analytical Chemistry-I(Separation Techniques)	2	Chem-328
Analytical Chemistry-II (Molecular Spectroscopy)	2	Chem-329
Analytical Chemistry Lab	1	Chem-330
Or		
Applied Chemistry-I (Water Treatment & Cleansers)	2	Chem-331
Applied Chemistry-II (Unit Processes & Chemical-I)	2	Chem-332
Applied Chemistry Lab	1	Chem-333
Or		
Bio Chemistry-I (Proteins)	2	Chem-334
Bio Chemistry-II (Nutrition)	2	Chem-335
Bio Chemistry Lab	1	Chem-336

**Total Credit Hours: 21**

**BS-ADP 7<sup>th</sup> Semester:**

Title	Credit hrs	Code
Thesis	4	Chem-400
<b>One group among the following six (Compulsory/minor)</b>		
Translation of Holy Quran	0	HQ-007
Physical Chemistry-I (Colloids)	2	Chem-401
Physical Chemistry Lab – I	1	Chem-402
Physical Chemistry-II (Surface Chemistry)	2	Chem-403
Physical Chemistry Lab – II	1	Chem-404
Physical Chemistry-III (Molecular Spectroscopy)	2	Chem-405
Physical Chemistry Lab - III	1	Chem-406
Physical Chemistry-IV (Solution Chemistry)	2	Chem-407
Or		
Inorganic Chemistry-I (Periodicity)	2	Chem-408
Inorganic Chemistry Lab - I	1	Chem-409
Inorganic Chemistry-II (Reagents and Solvents)	2	Chem-410
Inorganic Chemistry Lab - II	1	Chem-411
Inorganic Chemistry-III (Kinetic & Thermodynamic)	2	Chem-412
Inorganic Chemistry Lab - III	1	Chem-413
Inorganic Chemistry-IV (Environmental Aspects)	2	Chem-414
Or		
Organic Chemistry-I (Reaction Mechanism-II)	2	Chem-415
Organic ChemistryLab - I	1	Chem-416
Organic Chemistry-II (Oxidation & Reduction)	2	Chem-417
Organic ChemistryLab - II	1	Chem-418
Organic Chemistry-III (Reaction Mechanism-III)	2	Chem-419
Organic ChemistryLab - III	1	Chem-420
Organic Chemistry-IV (NMR Spectroscopy)	2	Chem-421
Or		
Analytical Chemistry-I (ElectroanalysisMethod-I)	2	Chem-422
Analytical Chemistry Lab – I	1	Chem-423

**BS (Chemistry)**

Analytical Chemistry-II (Atomic Spectroscopy)	2	Chem-424
Analytical Chemistry Lab – II	1	Chem-425
Analytical Chemistry-III ( Advance Chromatography)	2	Chem-426
Analytical Chemistry Lab – III	1	Chem-427
Analytical Chemistry-IV (Environmental Chemistry)	2	Chem-428

Or

Applied Chemistry-I (Fuel Chemistry)	2	Chem-429
Applied Chemistry Lab - I	1	Chem-430
Applied Chemistry-II (Steel & Metal Finishing)	2	Chem-431
Applied Chemistry Lab - II	1	Chem-432
Applied Chemistry-III (Analytical Techniques)	2	Chem-433
Applied Chemistry Lab - III	1	Chem-434
Applied Chemistry-IV (Processing Industries)	2	Chem-435

Or

Bio Chemistry-I (Nucleic Acids)	2	Chem-436
Bio Chemistry Lab - I	1	Chem-437
Bio Chemistry-II (Human Physiology)	2	Chem-438
Bio Chemistry Lab - II	1	Chem-439
Bio Chemistry-III (Enzymology)	2	Chem-440
Bio Chemistry Lab - III	1	Chem-441
Bio Chemistry-IV (Immunochemistry)	2	Chem-442

**Total Credit Hours****(for each group opted): 15****BS-ADP 8<sup>th</sup> Semester**

Thesis	6	4	Chem-400
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One group among the following six (Compulsory/minor)

Translation of Holy Quran	1	HQ-008
Physical Chemistry-I (Polymer Chemistry)	2	Chem-443
Physical Chemistry Lab - I	1	Chem-444
Physical Chemistry-II (UV & Raman Spectroscopy)	2	Chem-445
Physical Chemistry Lab - II	1	Chem-446
Physical Chemistry-III (Photochemistry)	2	Chem-447
Physical Chemistry Lab - III	1	Chem-448
Physical Chemistry-IV (Nuclear Chemistry)	2	Chem-449

Or

Inorganic Chemistry-I (Radioactivity)	2	Chem-450
Inorganic Chemistry Lab – I	1	Chem-451
Inorganic Chemistry-II (Bio-inorganic Chemistry)	2	Chem-452
Inorganic Chemistry Lab – II	1	Chem-453
Inorganic Chemistry-III (Organometallic Chemistry)	2	Chem-454
Inorganic Chemistry Lab - III	1	Chem-455
Inorganic Chemistry-IV (Inorganic Polymers)	2	Chem-456

Or

Organic Chemistry-I (Natural Products)	2	Chem-457
Organic Chemistry Lab – I	1	Chem-458
Organic Chemistry-II (Organic Synthesis)	2	Chem-459
Organic Chemistry Lab – II	1	Chem-460
Organic Chemistry-III (Heterocyclic Chemistry)	2	Chem-461

**BS (Chemistry)**

Organic Chemistry Lab – III	1	Chem-462
Organic Chemistry-IV (Reaction Mechanism-IV)	2	Chem-463
Or		
Analytical Chemistry-I (Electroanalysis Method-II)	2	Chem-464
Analytical Chemistry Lab – I	1	Chem-465
Analytical Chemistry-II (Compound Analysis)	2	Chem-466
Analytical Chemistry Lab – II	1	Chem-467
Analytical Chemistry-III (Thermoanalysis Method)	2	Chem-468
Analytical Chemistry Lab – III	1	Chem-469
Analytical Chemistry-IV (Conducto/Oscillometry)	2	Chem-470
Or		
Applied Chemistry-I (Polymers)	2	Chem-471
Applied Chemistry Lab – I	1	Chem-472
Applied Chemistry-II (Agro-industries)	2	Chem-473
Applied Chemistry Lab – II	1	Chem-474
Applied Chemistry-III (Textile Industries)	2	Chem-475
Applied Chemistry Lab – III	1	Chem-476
Applied Chemistry-IV (Environmental Chemistry)	2	Chem-477
Or		
Bio Chemistry-I (Lipids)	2	Chem-478
Bio Chemistry Lab – I	1	Chem-479
Bio Chemistry-II (Molecular Biology)	2	Chem-480
Bio Chemistry Lab – II	1	Chem-481
Bio Chemistry-III (Microbiology & Drug Metabolism)	2	Chem-492
Bio Chemistry Lab - III	1	Chem-483
Bio Chemistry-IV (Biochemical Techniques)	2	Chem-484
<b>Total Credit Hours</b> <b>(for each group opted):</b>	<b>16</b>	

**PHYSICAL CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-301</b>
<b>Module title:</b>	<b>Electrochemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will help in understanding basic principles of electrochemistry. Students will be able to use fundamental principles of electrochemistry in development of electrochemical devices like batteries and fuel cells.

**SYLLABUS OUTLINES**

Basics of electrochemistry, Idea of conductance of electrolytes and its determination, Debye-Huckle equation for all types of solution and limiting law, ionic strength, weak electrolyte and Debye-Huckle theory, Activity and activity coefficients of electrolytic solution, determination of activities, concentration cells, Types of concentration cells, derivation of E.M.F of electrode and electrolyte concentration cells with and without transference, basics of Fuel cells, classification of fuel cells: Alkaline fuel cells, molten carbonate fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, Proton exchange membrane fuel cells and hydrocarbon fuel cells.

**RECOMMENDED BOOKS**

1. Electrochemical Methods and applications by bard, A. and Faulkner, L.R., John Wiley, New York, 1980.
2. Arun Bahl, B S Bahl & G D Tuli, Essential of Physical Chemistry, S. Chand Publishing New Dehli, 2000.
3. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House Lahore, (2014).
4. Physical Chemistry, Samuel Glasstone, 1995. Macmillan and Co. Ltd. St. marlins Street, London.
5. Principles of Physical chemistry, Maron and Prutton, 1965 the Macmillan Company, Collier Macmillan Ltd. London.
6. Physical Chemistry, Barrow, 1973, McGraw Hill, Tokyo.
7. Physical Chemistry, Moore, 1972, Rentice Hall, Englewood cliffs, Jersey.
8. Physical Chemistry, Alberty and Daniels, 1962, McGraw Hill Book Company Ltd London.
9. Physical chemistry, Atkins, 1989, Oxford University Press, Walton Street, Oxford.
10. Physical Chemistry, Castellan, 1972, Addison Westey Publishing Company, Menla Park, California, London.

**PHYSICAL CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-302</b>
<b>Module title:</b>	<b>Quantum Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will help in understanding basic principles of kinetic theory of gases and quantum chemistry. This will assist students in calculating bond energies and bond length on the basis of quantum approach.

**SYLLABUS OUTLINES**

Postulates of quantum theory, Eigen functions, operators, Schrödinger's wave equation, particle in one dimensional box, Normalized wave function and orthogonality, Quantum mechanical tunneling, motion of particle in three dimensional box and idea of degeneracy, separation of variables and derivation of quantum numbers, Mathematical treatment of rigid rotator and calculation of bond length of simple molecules, harmonic oscillator and calculation of bond length of simple molecules, harmonic oscillator and calculation of vibrational frequencies, formation of covalent bond, Mathematical treatment of  $\text{He}_2^+$  and  $\text{H}_2$  molecules, discussion of overlapping integrals, molecular orbital theory and formation of  $\text{H}_2$  and  $\text{O}_2$  molecules. The van der Waals equation, Maxwell distribution of molecular velocities and energies, Derivation of average velocity and most probable velocity, Barometric formula, Maxwell-Boltzmann's law of energy distribution

**RECOMMENDED BOOKS**

1. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House, (2014).
2. Physical Chemistry, Samuel Glasstone, 1995. Macmillan and Co. Ltd. St. marlins Street, London.
3. Principles of Physical chemistry, Maron and Prutton, 1965 the Macmillan Company, Collier Macmillan Ltd. London.
4. Physical Chemistry, Barrow, 1973, McGraw Hill, Tokyo.
5. Physical Chemistry, Moore, 1972, Rentice Hall, Englewood cliffs, Jersey.
6. Physical Chemistry, Alberty and Daniels, 1962, McGraw Hill Book Company Ltd London.
7. Physical chemistry, Atkins, 1989, Oxford University Press, Walton Street, Oxford.
8. Physical Chemistry, Castellan, 1972, Addison Westey Publishing Company, Menla Park, California, London.

**PHYSICAL CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-303</b>
<b>Module title:</b>	<b>Physical Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The course will provide the practical grounds for the verification of fundamental principles of physical chemistry and applications of these principles. In addition it will enable the students to apply these practical methods in other branches of chemistry. Students will also learn the electrochemical measurements for determination of various physical constants like cell constant and dissociation constant etc. The course will be helpful for students to use conductometry in chemical analysis.

**SYLLABUS OUTLINES**

1. Preparation of standard molar and Normal solutions and percentage compositions of different substances.
2. Preparation of buffer solution ( $\text{CH}_3\text{COOH}$  and  $\text{CH}_3\text{COONa}$ ) of a certain pH.
3. Determination of the equivalence conductance of solution of weak electrolyte at various dilutions at room temperature to verify Oswald's law.
4. Determination of the strength of given base by titrating it against standard Acetic acid solution and HCl solution using conductivity meter.
5. To determine the strength of HCl and  $\text{CH}_3\text{COOH}$  in the given mixture of both by titrating it against NaOH conductometrically.

**RECOMMENDED BOOKS**

1. Advanced Experimental Physical Chemistry by Ayodhya Sing.
2. Experimental Physical Chemistry by Daniel
3. Experimental Physical Chemistry by G.Peter Matthews.
4. Experiments in Physical Chemistry by Shoemaker.

**INORGANIC CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-304</b>
<b>Module title:</b>	<b>Pi- Acceptor Ligands</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will help in understanding basic principles of Pi-Acceptor Ligands, Chemical Bonding and Coordination Compounds. This will assist students in understanding the chemistry of Pi-Acceptor Ligands.

**SYLLABUS OUTLINE:**

**1. Metal carbonyls:**

Transition metal carbonyls (Mononuclear, Binuclear, Polynuclear), Effective atomic number rule or the 18 electron rule, Synthesis and bonding situation based on spectroscopic evidences; Theoretical rationalization of molecular structures, Synthesis. Characteristics and reactivity of derivatives of metal carbonyls (carbonylate anions, carbonyl hydrides and carbonyl halides).

**2. Metal nitrosyls**

Transition metal nitrosyls including halonitrosyl and their derivatives, chemistry of nitroso ferrous sulphate, sodium nitroprusside, Applications of carbonyls and nitrosyls in industry and synthetic chemistry.

**RECOMMENDED BOOKS:**

1. Inorganic Chemistry by James E. Huheey 1983 Harper International London.
2. Pi-Acceptor Ligands by Zafar Iqbal 1982 U.G.C. Islamabad.
3. Coordination Compounds by S.F.A. Kettle, 1971, Nelson, (Nairobi Kenya).
4. Haq Nawaz Bhatti and Rabia Rehman, "Advanced Inorganic Chemistry", Carvan Book House Lahore.



**INORGANIC CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-305</b>
<b>Module title:</b>	<b>Chemical Bonding Theories</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will help in understanding basic principles of chemical Bonding and Coordination Compounds. This will assist students in understanding the structural chemistry of metal complexes and inorganic molecules.

**SYLLABUS OUTLINE:**

**Theoretical aspects of inorganic compounds:**

- (a) VSEPR model followed by VB theory (Hybridization, Resonance etc.,) explanation of the structure of  $AB_2$ ,  $AB_3$ ,  $AB_2E$ ,  $AB_4$ ,  $AB_3E$ ,  $AB_2E_2$ ,  $AB_5$ ,  $AB_3E_3$ ,  $AB_6$ ,  $AB_5E$ ,  $AB_4E_2$ ,  $AB_7$ ,  $AB_6E$ ,  $AB_8$  and  $AB_9$  type molecules.
- (b) Discussion of molecular orbitals and molecular structures of homo nuclear molecules and ions, hetero nuclear diatomic and polyatomic molecules and ions.
- (c) Bent bond, bridge bond, four electrons-three centre bond.
- (d) Shielding effect and effective nuclear charge, Factors affecting the magnitude of  $\sigma$  and  $Z_{\text{eff}}$  and their variation in the period table, Applications of Slater's rules, Polarization of ions, Fajan's rules and its applications.
- (e) Correlation diagram for triatomic and tetraatomic molecules.
- (f) Metallic bond on the basis of band model, X-ray spectra and  $N(E)$  curves,  $n(E)$  curves. Binding energy in metals, conductors, semi-conductors and insulators. Effect of temperature and impurities on conductivity.

**RECOMMENDED BOOKS:**

1. Theoretical Principles of Inorganic Chemistry by Manko, G.S. 1980, McGraw Hill.
2. Coordination Chemistry by B.A. Basallo and R. Johnson 1972 W.A. Benhamen, London.
3. Coordination Compounds by S.F.A. Kettle, 1971, Nelson, (Nauohi Kenya).
4. Selected topics of Inorganic Chemistry by G.D Tuli.
5. Haq Nawaz Bhatti and Rabia Rehman, "Advanced Inorganic Chemistry", Carvan Book House Lahore.
6. Stereochemistry and bonding in Inorganic Chemistry by J.E. Ferguson 1974, Prentice Hall, New Jersey.
7. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkineon 1972, Interscience, Publishers, London.

**INORGANIC CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-306</b>
<b>Module title:</b>	<b>Inorganic Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

This course will help in understanding Aqueous Acid-base titration and Argentometric Titrations. This will assist students calculating aqueous acid base titration, estimation of oxalic acid, SO<sub>2</sub>, SO<sub>3</sub> CO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, Determination of %age purity of H<sub>3</sub>BO<sub>3</sub> and Determine the %age composition of carbonate and bicarbonate in a mixture.

**SYLLABUS OUTLINE:**

**1. Aqueous Acid-base Titrations:**

- Estimation of SO<sub>2</sub> and SO<sub>3</sub> in air and discharged from an industrial process.
- Estimation of CO<sub>2</sub>
- Estimation of oxalic acid and H<sub>2</sub>SO<sub>4</sub> in a mixture.
- Determination of %age purity of H<sub>3</sub>BO<sub>3</sub>.
- Determine the %age composition of carbonate and bicarbonate in a mixture.

**2. Argentometric Titrations:**

- Mohr's Method
- Volhard's Method
- Adsorption Indicator Method (Fajan's Method)

**RECOMMENDED BOOKS:**

- Vogel, I. (1724). A Text-Book Of Macro And Semimicro Qualitative Inorganic Analysis. Willam Clowes And Sons Limited; London; Bxccles.
- Vogel, Arthur I. A Text-Book Of Quantitative Inorganic Analysis-Theory And Practice. Longmans, Green And Co.; London; New York; Toronto, 2013.
- Quantitative Analysis Chemistry, James S. Pritz, George H. Schenk, 1987 Alby and Becon Inc. London.
- Rabia Rehman and Haq Nawaz Bhatti, "Experimental Inorganic Chemistry", Carvan Book House Lahore in 2015.
- Haq Nawaz Bhatti and Rabia Rehman "Advanced Experimental Inorganic Chemistry" Carvan Book House Lahore in 2017.
- Mendham, John. Vogels textbook of quantitative chemical analysis. Pearson Education India, 2006.

**ORGANIC CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-307</b>
<b>Module title:</b>	<b>Fundamental Concepts</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 Credits</b>

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**OBJECTIVES**

To develop understanding of the rules and basic principles working behind different properties and reactions of organic molecules. To gain knowledge about systematic naming of different types of organic compounds.

**SYLLABUS OUTLINES**

**1. Basic Concepts**

Electronic (Inductive and resonance) effects, steric and solvent effects, hyper-conjugation, hydrogen bonding, tautomerism, strength of acids and bases (pKa and Ka values), Influence of all these phenomena on the strength of acids and bases, aromaticity along with non- and anti-aromaticity.

**2. Stereochemistry**

Rotation around a single bond and the concept of conformational analysis in ethane, propane, butane, pentane, cyclo-pentane, cyclo-hexane, and cis/trans decalin system. Optical isomerism up to three chiral carbon atoms, enantiomers and diastereomers, racemates, racemization and resolution of racemates, epimerization, stereoisomerism of cyclic diphenyls.

Cis/Trans nomenclature, Z and E conventions, determination of configuration, geometrical isomerism in open chain and cyclic compounds, R/S system of nomenclature for isomers with more than one asymmetric carbon, Optical activity

**RECOMMENDED BOOKS:**

1. Organic Chemistry, (4<sup>th</sup> - 7<sup>th</sup> Ed) by Paula Yurkanis Bruice, Pearson Education (Singapore) Pvt. Ltd. 2004-2015.
2. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
3. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
4. A Text-Book of Organic Chemistry by M. Younas, ILMI, Pakistan.
5. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
6. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
7. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and r.K. Boyd, Benjamin Cummings, 1992.
8. Modern Synthetic Reactions, (2<sup>nd</sup> Ed.) by H.O. House, W.A. Benjamin Inc., Menlo Park, CA.
9. Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.
10. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

**ORGANIC CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-308</b>
<b>Module title:</b>	<b>Named Reactions</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 Credits</b>

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**OBJECTIVES**

To acquire knowledge about mechanisms and applications of a set of classic and well known reactions in organic synthesis.

**SYLLABOUS OUTLINES:**

**1. Active Methylene Compounds**

Enols and enolates, Kinetic and thermodynamic enolates, alkylation, acylation and halogenation of active methylene compounds, acid and base catalyzed reactions of mono-functional and bi-functional active methylene compounds e.g. malonic ester,  $\beta$ -ketoester, cyanoester, malononitrile, and dinitro compounds etc. Cyclization and decarboxylation.

**2. Named Reactions**

Description, Conditions, mechanism and synthetic applications of the following named reactions; Aldol, Claisen, Dieckmann, Perkin, Henry, Knoevenagel, Reformatsky, Darzen's (glycosidic ester synthesis), and Mannich reaction.

**RECOMMENDED BOOKS:**

1. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
2. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
3. A Text-Book of Organic Chemistry by M. Younas, ILMI, Pakistan.
4. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
6. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and R.K. Boyd, Benjamin Cummings, 1992.
7. Modern Synthetic Reactions, (2<sup>nd</sup> Ed.) by H.O. House, W.A. Benjamin Inc., Menlo Park, CA.
8. Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.
9. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

**ORGANIC CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-309</b>
<b>Module title:</b>	<b>Organic Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 Credit</b>

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**OBJECTIVES**

To develop experimental skills for certain organic reactions, estimation of sugars and detections of functional groups.

**SYLLABOUS OUTLINES:**

1. **Organic Preparations:**  
Benzoic acid from benzaldehyde (Cannizzaro) and from toluene (KMnO<sub>4</sub>); ethyl benzene from acetophenone; benzilic acid from benzyl and benzyl from benzoin, Iodoform reaction etc.
2. **Quantitative and Qualitative Analysis of Organic compounds:**  
Estimation of glucose, and number of acetyl groups, functional group allocation, etc.

**RECOMMENDED BOOKS:**

1. The Systematic Identification of Organic Compounds (8<sup>th</sup> Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5<sup>th</sup> Ed.) by A.I. Vogel et al. Longman, UK, 1989.
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. Advanced Practical Organic Chemistry (2<sup>nd</sup> Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.

**ANALYTICAL CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-310</b>
<b>Module title:</b>	<b>Analytical Data Handling</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

This course will help the students in assessing the analytical data. The students will be able to apply various statistical tests to interpret their observations and the obtained data.

**SYLLABUS OUTLINE:**

**1. Introduction / Assessment of Analytical Data**

Introduction and scope of Analytical Chemistry: Analytical problems and their solutions; The nature of analytical methods; trends in analytical methods; Different units of concentration and their conversion; Definition and basic concepts: nature and origin of errors, Classification of errors; Accuracy and Precision; Limits of detection, Confidence limits; Deviation, Standard deviation, Application of statistical tests; Rounding off analytical data; Quality control charts; Computation of analytical data. Significance of sampling, weighing and measuring in Analytical chemistry.

**RECOMMENDED BOOKS:**

1. Analytical Chemistry by J.D. Dick, McGraw Hill, 1973, N.Y. also available in International students edition McGraw Hill, Mogakusha, 1973.
2. Instrumental Methods by W.Ewing, Mc Graw Hill Book Co. N.Y. (Third/Fourth Edition) also available in International students edition.

**ANALYTICAL CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-311</b>
<b>Module title:</b>	<b>Chromatography</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

This course will help the students in understanding basic chromatographic techniques. Involving separation of complex mixture. The students will be able to understand ion exchange methods. The students will also learn about the basic concepts of chromatography.

**SYLLABUS OUTLINE:**

1. **Basic Chromatographic Techniques**  
Basic principle of chromatography, Classifications of Chromatographic Techniques, Column, Paper and Thin Layer Chromatographic Techniques; their instrumentation, applications and limitations.
2. **Ion Exchange Chromatography:**  
Cation Exchange resin, Anion Exchange resin, Cross-linkage, Effect of pH on Amino Acids, Metal ions on Anions/Cations Exchange Columns, Applications of ion Exchange Chromatography.

**RECOMMENDED BOOKS:**

1. Chromatography by R.K Sharma , Gogel publishing home Meerut
2. Introduction to chromatography by Nasir-ud-din, Published by author
3. Modern analytical chemistry by David Harvey, Roohani-art press, Islamabad
4. Principle and Practice of analytical chemistry by Fillfield, Blackwell Science Ltd
5. Fundamentals of Chromatography by H.G. Cassidy, Inter Science Publisher, London, N.Y.
6. Fundamentals of Analytical Chemistry by Douglas Skoog and Donald M. W. West, Holt Reinhart and Inc, London.
7. Analytical Chemistry by G. D. Christian,

**ANALYTICAL CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-312</b>
<b>Module title:</b>	<b>Analytical Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

This course will help the students in assessing the analytical data regarding calibration. The students will be able to apply various statistical tests to interpret their observations and the obtained data of analytical apparatus.

**SYLLABUS OUTLINE:**

**1. Calibration**

Calibration of glassware (pipette, burette and flask) used for volumetric analysis. Use of analytical balance and calculation of standard deviation. Calibration of pH meter and determination of pH of various acidic and basic solution.

Calibration of conductometer and determination of conductance of tap water, distilled water, conductivity water and canal water.

Calculation of dissociation constants of various acids.

Calculation of variance, mean, median, coefficient of variance of the data.

**RECOMMENDED BOOKS:**

1. Vogels, a text book of quantitative inorganic analysis by J. Bassett. The English language book Society and Longman.
2. Introduction to chromatography by Nasir-ud-din, Published by author.
3. Paper chromatography by Dr. Friedrich Cramer, London Macmillan and Co Ltd.
4. Thin- layer chromatography by Marini, Elsevier publisher.



**APPLIED CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-313</b>
<b>Module title:</b>	<b>Unit Operations &amp; Chemicals</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will help the students in assessing the Unit Operations in Chemical Industry, Basic Chemical Industries and Cement Industries. The students will learn about the basic concepts of chemical industries.

**SYLLABUS OUTLINE:**

1. **Unit Operations in Chemical Industry:**  
Introduction to chemical industry with reference to Pakistan, Chemistry vs Chemical Engineering, Flow sheet Diagrams, Brief Introduction of different unit operations used in chemical industry. Heat Flow, Convection, Conduction, Heat Exchangers, Distillation, Evaporation, Size Reduction and Size Separation and Filtration.
2. **Basic Chemical Industries:**  
Raw materials; Chemical processes involved; flow sheet diagrams with all the important parameters concerned with the manufacturing of Phosphoric acid; caustic Soda; Calcium oxychloride; Phenol, Phthalic anhydride, Oxalic acid, Paracetamol, and Aspirin, Applications of these chemicals in industry.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Unit operations in Chemical Engineering, Chattopadhyay, Khanna Publishers, Delhi-6.(1993).
3. Hand Book of Industrial Chemicals, By SIRI Board of Consultants and Engineers,
4. Small Industries Research Institute, New Delhi (1995)
5. Small Medium and large Scale Industries, A.K. Sirivastawa, Small Industries Research Institute, New Delhi (1996).
6. The Chemistry of Cement, H.F.W. Taylor, Academic Press, London, 1964.
7. Shereve's Chemical Process Industries, 5th Ed.1975 by G.T.Austin McGraw Hill Book Co. New York.
8. Industrial chemistry, B. K. Sharma Krishna Prakashan Media (P) Ltd., Ed-15 (2006).

**APPLIED CHEMISTRY (BS-ADP5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-314</b>
<b>Module title:</b>	<b>Allied Chemical Industries</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

It will help the students to understand the working in Allied Chemical Industries starting from raw material to end finished product.

**SYLLABUS OUTLINE:**

**1. Cement Industries:**

Glossary of Cement Terms, Raw materials used for cement manufacturing, Dry process and Wet process, Semi-wet process, Types of Cement, Hydration of Cement, Properties of Cement, Testing of Cement, and Allied Cementing materials

**2. Glass and Ceramics:**

Glass – Physical and Chemical properties of glass, types of glass, raw materials used for glass, manufacturing of special glass.

Ceramics – Classification and properties of ceramics, raw materials, manufacturing of ceramics, application of colors to pottery, refractory.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Industrial Organic Chemicals, by H.A.Witcoff and B.J.Reuben, John Wiley & Sons Inc. New York.
3. Hand Book of Industrial Chemicals, By SIRI Board of Consultants and Engineers,
4. The Chemistry of Cement, H.F.W. Taylor, Academic Press, London, 1964.
5. Shereve's Chemical Process Industries, 5th Ed.1975 by G.T.Austin McGraw Hill Book Co. New York.
6. Industrial chemistry, B. K. Sharma Krishna Prakashan Media (P) Ltd., Ed-15 (2006)
7. Chemistry of glass manufacturing, F.W.Hunter, Dower Publications, New York, 1950.

**APPLIED CHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-315</b>
<b>Module Title:</b>	<b>Applied Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

This course content will increase the working skills of students regarding water testing labs and cosmetic industries.

**SYLLABUS OUTLINE:**

**1. Preparations:**

Detergent and cosmetics (Cold cream, shampoo and vanishing cream)

**2. Titrimetry:**

Estimation of water hardness by complexometry

Estimation of TSS and TDS in water

Determination of acidity, alkalinity, Free CO<sub>2</sub> in water

Determine the %age purity of the Commercial sample of sodium chloride.

**3. Spectrophotometry:**

Determination of the of KMnO<sub>4</sub>, K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> and CoCl<sub>2</sub> ( $\lambda_{\max}$  and Beer's law verification)

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Unit operations in Chemical Engineering, Chattopadhyay, Khanna Publishers, Delhi-6.(1993).
3. Hand Book of Industrial Chemicals, By SIRI Board of Consultants and Engineers,
4. Small Industries Research Institute, New Delhi (1995)
5. Small Medium and large Scale Industries, A.K. Sirivastawa, Small Industries Research Institute, New Delhi (1996).
6. The Chemistry of Cement, H.F.W. Taylor, Academic Press, London, 1964.
7. Shereve's Chemical Process Industries, 5th Ed.1975 by G.T.Austin McGraw Hill Book Co. New York.
8. Industrial chemistry, B. K. Sharma Krishna Prakashan Media (P) Ltd., Ed-15 (2006)

**BIOCHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-316</b>
<b>Module title:</b>	<b>Carbohydrates</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will help students to understand major types of carbohydrates and their function in the human body. Students will be able to learn metabolism and metabolic pathways of carbohydrates. It will also help in understanding of ATP production in cell, normal level of blood sugar and its regulation.

**SYLLABUS OUTLINES**

Introduction, occurrence and importance of Carbohydrates in biosphere and life processes. classification of carbohydrates; chemistry, physical, chemical properties and biological significance of monosaccharide's, oligosaccharides and polysaccharides; Homo-polysaccharides and Hetro-polysaccharides with special emphasis on Glycosaminoglycans. Haworth configuration, D and L configuration of monosaccharides. Optical isomerism and mutarotation in glucose. Invert sugar. A brief discussion of digestion, absorption, and transport of Carbohydrates. Description about the Metabolism, biological importance and ATP production of carbohydrates; glycolysis, citric acid Cycle, HMP pathway, uronic acid pathway. gluconeogenesis, glycogenesis, glycogenolysis, electron transport chain, oxidative phosphorylation and uncoupler agents involved in oxidative phosphorylation.

**RECOMMENDED BOOKS**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000  
Pub: worth Publishers
2. Biochemistry by Lubert Stryer(2006) Pub: Freeman and Company
3. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.
4. Lippincott's Biochemistry by Champ C; Harvey.R.A and Ferrie.D.R. 3<sup>rd</sup> Edition., Pub: J.B. Lippincott company

**BIOCHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-317</b>
<b>Module title:</b>	<b>General Biochemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will enable students to understand Fundamental principles of biochemistry. Students will also learn difference between prokaryotic and eukaryotic cells, organelles properties of water, buffers and their role in the human body.

**SYLLABUS OUTLINES**

Scope and molecular basis of Biochemistry in life. Introduction of living cells; Prokaryotes and Eukaryotes. A brief description on the isolation, structure and functions of cellular organelles. Water; structure, properties of water and aqueous solution. Colligative properties of water and its importance in life. Water interaction in aqueous system. Ionization of water, weak acids and weak bases. pH, Handerson-Hasselbalch equation and buffer systems. Different buffering agents and their importance in biological systems. Electrolytes and acid base balance in body.

**RECOMMENDED BOOKS**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000 Pub: Worth Publishers
2. Biochemistry by Lubert Stryer (2006) Pub: Freeman and Company
3. A biologist's guide to Principles and Techniques of Practical Biochemistry by Bryan L Williams and Keith Wilson Pub: Edward Arnold Ltd.
4. Harpers Biochemistry, 27th Ed. (2006) McGraw Hills Inc.

**BIOCHEMISTRY (BS-ADP 5<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-318</b>
<b>Module title:</b>	<b>Bio Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 5<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

This course will provide the grounds for distinction between various carbohydrates. In addition, it will help students to apply these practical methods on sugar level determination of human's blood and urine.

**SYLLABUS OUTLINES**

- Awareness about the preparation of the laboratory solution and pH determination.
- Qualitative and Quantitative tests of various Carbohydrates; Distinction between pentoses and hexoses, aldoses and Ketoses, reducing and non-reducing sugars, mono and polysaccharides.
- Qualitative tests for polysaccharides; starch, glycogen and cellulose.
- Extraction of starch from plant source and its confirmatory tests.
- Acid and enzymatic hydrolysis of polysaccharide.
- Analysis of organic constituents in human urine.
- Determination of sugar level in blood and urine.
- Estimation of glucose in urine.

**RECOMMENDED BOOKS**

1. Practical clinical Biochemistry by Varley. Pub: C B S Publishers An
2. Introduction to Practical Biochemistry by D. T. Plummer Pub: McGrawHill
3. Varleys Practical Clinical Biochemistry 6th Edition (English, Hardcover, Alan H. Gowenlock)
4. A biologist's guide to Principles and Techniques of Practical Biochemistry by Bryan L Williams and Keith Wilson Pub: Edward Arnold Ltd.

**PHYSICAL CHEMISTRY (BS-ADP 6<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-319</b>
<b>Module title:</b>	<b>Chemical Kinetics</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will acquire knowledge to enable themselves to understand the fundamental principles of chemical kinetics and laws of thermodynamics. Students will also be able to explore the insights of reactions occurring in solution phase and perform related calculations.

**SYLLABUS OUTLINES**

**Chemical kinetics**

Concept of rate law and order of reaction, Kinetics of 3rd order reaction with different concentrations and molecular identity, kinetics of opposing, parallel and consecutive reactions, basic experimental methods, Kinetics of thermally excited chain reactions like reaction of H<sub>2</sub> and Br<sub>2</sub>, kinetics of thermal decomposition of ozone, N<sub>2</sub>O<sub>5</sub> and CH<sub>3</sub>CHO.

Effect of temperature on reaction rate, mathematical treatment of collision theory and transition state theory of bimolecular reactions, Comparison of collision theory and Transition state theory with Arrhenius theory, Calculation of entropy and enthalpy by Eyring equation, effect of ionic strength, hydrostatic pressure on the rate of reaction in solution.

**RECOMMENDED BOOKS**

1. Atkin, P. and Paula, J. D., Atkin's Physical Chemistry, 2nd ed., Oxford University Press, (2002).
2. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House, (2014).
3. Physical Chemistry by Kundu, N and Jain, S.K., S. Chand and Company Ltd. 1984.
4. Fundamentals of Chemical kinetics by Logan, S.R., Longman Group Ltd. 1996.
5. Elementary reaction kinetics by Latham. J.L. and Burgess, A.E., 3rd Ed., Butterworths, London, 1997.
6. Physical Chemistry by Atkins, P.W., 5th Ed., W.H. Freeman and Company, New York, 1994.
7. Physical Chemistry by Alberty, R.A. and Silbey, R.J., John Wiley, New York, 1995.
8. Physical Chemistry by Engel, T. and Ried, P., 1st Ed., Pearson education, Inc. 2006.

**PHYSICAL CHEMISTRY (BS-ADP 6<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-320</b>
<b>Module title:</b>	<b>Thermodynamics</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will acquire knowledge to enable themselves to understand the fundamental principles and laws of thermodynamics. The course will be helpful for students for basic understanding of statistical thermodynamics. Students will also be able to explore the insights of reactions occurring in solution phase and perform related calculations.

**SYLLABUS OUTLINES**

Brief introduction of second law of thermodynamics, Clausius inequality, Nernst heat theorem and its applications, Nernst approximation, Maxwell's Relations, third law of thermodynamics, Experimental verification of third law of thermodynamics. Entropy change in solid/liquid and ideal gas, Adiabatic demagnetization.

Sterling's approximation, partition function (Q), its derivation and physical significance, Energy of system in terms of partition function, expression of thermodynamic functions (energy, enthalpy, entropy, heat capacity at constant pressure and volume and free energies) in terms of translational partition function ( $Q_t$ ), rotational partition function ( $Q_r$ ), vibrational partition function ( $Q_v$ ) and electronic partition function ( $Q_e$ ), Separation of partition functions, expression of free energy and equilibrium constant of reversible chemical reaction in terms of partition function. Entropy and probability.

**RECOMMENDED BOOKS**

1. Atkin, P. and Paula, J. D., Atkin's Physical Chemistry, 2nd ed., Oxford University Press, (2002).
2. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House, (2014).
3. Physical Chemistry by Kundu, N and Jain, S.K., S. Chand and Company Ltd. 1984.
4. Fundamentals of Chemical kinetics by Logan, S.R., Longman Group Ltd. 1996.
5. Elementary reaction kinetics by Latham. J.L. and Burgess, A.E., 3rd Ed., Butterworths, London, 1997.
6. Physical Chemistry by Atkins, P.W., 5th Ed., W.H. Freeman and Company, New York, 1994.
7. Physical Chemistry by Alberty, R.A. and Silbey, R.J., John Wiley, New York, 1995.
8. Physical Chemistry by Engel, T. and Ried, P., 1st Ed., Pearson education, Inc. 2006.
9. Principles of Physical Chemistry by Maron and Prutton, Macmillan and Co. Ltd. 1965.
10. Physical Chemistry by Glasstone, S. Macmillan and Co. Ltd., London, 195.
11. Elements of classical and statistical thermodynamics by Nash, L.K. Addison Wesley Co. Ltd., 1979



**PHYSICAL CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-321</b>
<b>Module title:</b>	<b>Physical Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The course will be helpful for students in basic understanding of various physical methods of analysis like refractometry, cryoscopy, spectrophotometry and polarimetry.

**SYLLABUS OUTLINES**

1. Determination of the percentage composition of a binary solution by refractometry.
2. Determination of the molar mass of a substance by cryoscopic method.
3. Determination of concentration of given colored solution using spectrophotometer.
4. Determination of the eutectic point of a binary mixture (Naphthalene and diphenyl, urea and phenol, benzoic acid and naphthalene) system.
5. Determination of percentage composition of a solution of an optically active substance (Sucrose, glucose).

**RECOMMENDED BOOKS**

1. Advanced Experimental Physical Chemistry by Ayodhya Sing.
2. Experimental Physical Chemistry by Daniel
3. Experimental Physical Chemistry by G.Peter Matthews.
4. Experiments in Physical Chemistry by Shoemaker.

**INORGANIC CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-322</b>
<b>Module title:</b>	<b>Coordination Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will familiarize to students about the covalent bond, co-ordination compounds and lanthanides and actinides of chemistry. The students will get knowledge about the VB theory, molecular orbitals and molecular structures of homo nuclear molecules and ions, various kinds of bonds. This course will also assist the students to know about the coordination compounds such as preparative methods, techniques of studying complexes, stability constants, nomenclature, separation and electronic configuration, applications of Lanthanides and Actinides.

**SYLLABUS OUTLINE:**

**Coordination Chemistry**

**1. Structure & Bonding**

Development of coordination compounds, Rules of nomenclature of inorganic compounds. Hybridization in coordination compounds with coordination number from 2 to 9. MO diagrams for metal complexes of common geometry. Important features of CFT, d-orbitals splitting for various common geometries, measurement of  $10 Dq$ , factors effecting  $10 Dq$ . CFSE, factors influencing magnitude of variation in lattice and hydration energy for ions of first transition series.

**2. Synthesis and properties**

Preparative methods. Techniques of studying complexes, stability constants. The spectrochemical series and colour of metal complexes. Diamagnetism and Para magnetism, stereochemistry, John-Teller Theorem, Isomerism. Role of metal complexes in analytical chemistry, industry and nature.

**RECOMMENDED BOOKS:**

1. Coordination Chemistry by B.A. Basallo and R. Johnson 1972 W.A. Benhamen, London.
2. Selected topics of Inorganic Chemistry by G.D Tuli.
3. Haq Nawaz Bhatti and Rabia Rehman, Advanced Inorganic Chemistry", Carvan Book House Lahore.
4. R.D.Madan, Satya Prakash's Modern Inorganic Chemistry, S. Chand Company and Ltd, 2002.
5. J.D.Lee, Concise Inorganic Chemistry, 5<sup>th</sup> Edition.

**INORGANIC CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-323</b>
<b>Module title:</b>	<b>f-block elements</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will familiarize to students about lanthanides and actinides chemistry. The students will get knowledge about their discovery, extraction, separation, electronic configuration and their applications

**SYLLABUS OUTLINE:**

**1. Chemistry of Lanthanides**

Types and shapes of 'f'-orbitals, Nomenclature, Position in periodic table, occurrence, Separation, and electronic configuration, oxidation States, Ionic radius, Complex Formation, Comparison of Lanthanides and Actinides, applications of Lanthanides.(Nuclear and Non Nuclear).

**2. Chemistry of Actinides**

Nomenclature, Position in periodic table, occurrence, Separation, and electronic configuration, oxidation States, Ionic radius, Complex Formation, Synthesis of transuranic elements, extraction of Uranium and Thorium, applications of Actinides (Nuclear and Non Nuclear).

**RECOMMENDED BOOKS:**

1. Inorganic Chemistry by James E. Huheey 1983 Harper International London.
2. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkineon 1972, Interscience, Publishers, London.
3. Selected topics of Inorganic Chemistry by G.D Tuli.
4. Haq Nawaz Bhatti and Rabia Rehman, Advanced Inorganic Chemistry”, Carvan Book House Lahore.
5. J.D.Lee, Concise Inorganic Chemistry, 5<sup>th</sup> Edition.

**INORGANIC CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-324</b>
<b>Module title:</b>	<b>Inorganic Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The aim of this course is to interpret the concepts for better understanding in inorganic chemistry. This course will familiarize the students to determine the complexometric titrations, Redox titrations and preparations of some compounds.

**SYLLABUS OUTLINE:**

**1 Complexometric Titrations:**

Estimation of  $Mg^{+2}$ , and  $Zn^{+2}$  with EDTA (Direct titration).

Estimation of  $Ni^{+2}$  with EDTA (Back titration).

Determination of  $Ca^{+2}$  and  $Mg^{+2}$  in a mixture

Determination of  $Co^{2+}$  and  $Pb^{+2}$  by using Xylenol Orange Indicator.

**2 Redox Titrations:**

**(a) Iodimetry**

Determine the amount of Iodine dissolved in water using  $Na_2S_2O_3$

**(b) Use of potassium iodate for the determination of the followings:**

i) KI    ii) Copper    iii)  $H_2O_2$     iv) Commercial Hypochlorite

**RECOMMENDED BOOKS:**

1. Vogel, Arthur I. A Text-Book Of Quantitative Inorganic Analysis-Theory And Practice. Longmans, Green And Co.; London; New York; Toronto, 2013.
2. Rabia Rehman and Haq Nawaz Bhatti, "Experimental Inorganic Chemistry", Carvan Book House Lahore in 2015.
3. Haq Nawaz Bhatti and Rabia Rehman "Advanced Experimental Inorganic Chemistry" Carvan Book House Lahore in 2017.
4. Mendham, John. Vogels textbook of quantitative chemical analysis. Pearson Education India, 2006.

**ORGANIC CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-325</b>
<b>Module title:</b>	<b>Reaction Mechanism-I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 Credits</b>

**OBJECTIVES:**

To grasp ideas about the mechanisms, basic rules and principles working behind different types of electrophilic and nucleophilic substitutions and free radical reactions of organic compounds.

**SYLLABUS OUTLINES:**

**1. Aromatic Substitution reactions**

**a. Electrophilic Aromatic Substitutions:**

General mechanism (kinetic, isotopic and spectroscopic evidences), nitration, sulfonation, halogenation, Friedel-Crafts alkylation and acylation, orientation and reactivity; poly-substitution reactions of aromatic compounds.

**b. Nucleophilic Aromatic Substitutions:**

Addition and elimination mechanism, Benzyne mechanism, Radical mechanism, Sandmeyer reaction and its examples.

**2. Free Radical Reactions**

Introduction, generation methods, relative stability, structure, free radical reactions and industrial applications.:

**RECOMMENDED BOOKS:**

1. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
2. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
3. A Text-Book of Organic Chemistry by M. Younas, ILMI, Pakistan.
4. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
6. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and R.K. Boyd, Benjamin Cummings, 1992.
7. Modern Synthetic Reactions, (2<sup>nd</sup> Ed.) by H.O. House, W.A. Benjamin Inc., Menlo Park, CA.
8. Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.
9. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

**ORGANIC CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-326</b>
<b>Module title:</b>	<b>Spectroscopy</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 Credits</b>

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**OBJECTIVES:**

To acquire knowledge of the instrumentation, working and applications of UV/Visible and IR spectroscopy and role of these techniques for the characterization of organic compounds.

**SYLLABUS OUTLINES:**

**1. Spectroscopy**

**a. Infra-Red (IR) Spectroscopy**

Electromagnetic radiations: IR; modes of vibration, sampling techniques, Vibration frequencies of different functional groups, factors influencing the vibration frequencies and applications of IR spectroscopy.

**b. Ultra-Violet (UV) and Visible Spectroscopy**

Ultraviolet (UV) or electronic spectroscopy: electronic transitions; factors influencing the  $\lambda_{\max}$  values, Woodward-Fieser rules for calculations of  $\lambda_{\max}$ . Applications of UV-Vis. Spectroscopy.

**RECOMMENDED BOOKS:**

1. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
2. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
3. A Text-Book of Organic Chemistry by M. Younas, ILMI, Pakistan.
4. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
6. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and R.K. Boyd, Benjamin Cummings, 1992.
7. Modern Synthetic Reactions, (2<sup>nd</sup> Ed.) by H.O. House, W.A. Benjamin Inc., Menlo Park, CA.
8. Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.
9. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

**ORGANIC CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-327</b>
<b>Module title:</b>	<b>Organic Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 Credit</b>

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**OBJECTIVES**

To gain experimental skills for different organic transformations, separation and identification of two components in a mixture of unknown compounds via systematic physical and chemical tests.

**SYLLABUS OUTLINES:**

**1. Organic Preparations**

Synthesis of aromatic nitro, halogens, amines, carboxylic acid, aldehyde and related compounds. (Depending upon the availability of chemicals and reagents)

**2. Quantitative and Qualitative Analysis of Organic compounds**

**Mixture Analysis**

Physical/ Chemical separation of mixture containing two Compounds, identification, confirmation and derivatization.

**RECOMMENDED BOOKS:**

1. The Systematic Identification of Organic Compounds (8<sup>th</sup> Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5<sup>th</sup> Ed.) by A.I. Vogel et al. Longman, UK, 1989.
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. Advanced Practical Organic Chemistry (2<sup>nd</sup> Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.

**ANALYTICAL CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-328</b>
<b>Module title:</b>	<b>Separation Techniques</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

The course will enable the students to understand the use and mechanism of separation techniques (solvent extraction and electrophoresis) and their application in sample preparation.

**SYLLABUS OUTLINE:**

1. **Solvent Extraction:**  
Basic principle of solvent extraction, The Distribution Coefficient, The Distribution Ratio, The Percent Extraction Ion, Solvent Extraction of Metals, Multiple Batch Extractions, Countercurrent Distribution
2. **Solid-Phase Extraction:**  
Basic Principle, Mechanism of Separation, Sample Characteristics, Properties of Sorbents, Elution process, SPME
3. **Electrophoresis:**  
Basic Principle, Types of Electrophoresis, Analytical Protocol, Application of Electrophoresis.

**RECOMMENDED BOOKS:**

1. Vogels, text book of Quantitative chemical analysis by J. Mendham, RCDenny, JDBarnes, MJ KTHomas, Pearson education Ltd.
2. Advances in electrophoresis by Andrea Chrmambach , Wiiley- VCH.
3. Solvent Extraction by Gorge H. & Morrison Hener, John Wiley and sons, London, N.Y.
4. Analytical Chemistry by G.D. Christian.



**ANALYTICAL CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-329</b>
<b>Module title:</b>	<b>Molecular Spectroscopy</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

The course will enable the students to understand the use and mechanism of separation techniques (solvent extraction and electrophoresis) and their application in sample preparation. In addition, the students will acquire knowledge about the useful atomic spectroscopic techniques like AES, ICP, AFS and AAS. The students will learn these techniques and their applications in chemical analysis

**SYLLABUS OUTLINE:**

1. **Introduction to Spectroscopy/Spectrophotometry**  
Introduction to Molecular spectroscopy, absorption in UV and Visible range; Basic principle of Spectrophotometry; Beer-Lambert's law; Deviations; Instrumentation and application.
2. **FTIR / Raman Spectroscopy:**  
Origin of Infra Red Spectra; Different vibrational modes, Normal coordinate and normal vibrations, Symmetry of normal vibrations and selection rule, Raman Spectroscopy,, Vibrational Spectra in gaseous phase and inert gas matrices; Comparison of raman with Infra Red spectroscopy; Applications for qualitative and quantitative chemical analysis; Instrumentation details and their function.
3. **UV / Vis Spectroscopy:**  
The Nature of Electromagnetic Radiation, The Electromagnetic Spectrum, Atomic Energy Levels, molecular Electronic Energy Levels, Instrumentation Radiation Sources, Wavelength Selection, Cells and Sampling Devices, Detectors, Readout Modules and application.

**RECOMMENDED BOOKS:**

1. Chemical Application of Spectroscopy by West, Inter Science Publisher Inc. N.Y. London.
2. Kinetics in Analytical Chemistry by H.B. Mark Jr. & G.A. Rechnitz, Interscience N.Y. (1968).
3. Analytical Chemistry by Gary D. Christian, John Wiley and Sons (1977).
4. Automated Chemical Analysis by J.K. Forman Stockwell, John Wiley and Sons, N.Y. (1975).
5. Advances in Infrared Group Frequencies by L.J. Bellacy, Mathuen & Col. Amsterdam (1968).
6. Fundamentals of Molecular Spectroscopy by Banwell.

**ANALYTICAL CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-330</b>
<b>Module title:</b>	<b>Analytical Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

Outline of this course covers latest analytical separation techniques involving different types of chromatography. It also finds its applications in various fields regarding organic and inorganic separations.

**SYLLABUS OUTLINE:**

**1. Molecular Spectrophotometry:**

- Separation of ink components by paper chromatography
- Separation of amino acids by thin layer chromatography
- Separation of dyes by column chromatography
- Separation of mixtures by circular paper chromatography

**RECOMMENDED BOOKS:**

1. Vogel's text book of quantitative inorganic analysis by J. Bassett. The English language book Society and Longman
2. Introduction to chromatography by Nasir-ud-din, Published by author
3. Paper chromatography by Dr. Friedrich Cramer, London Macmillan and Co. Ltd
4. Thin-layer chromatography by Marini, Elsevier publisher

**APPLIED CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-331</b>
<b>Module title:</b>	<b>Water Treatment and Cleansers</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course content will help the students to understand the chemistry of water regarding its industrial use especially. It will also help them to learn about the operations and processes involved in manufacturing of soaps and detergents.

**SYLLABUS OUTLINE:**

**1. Water For Industry:**

Importance of Water in industry; Criteria of water quality for industrial use; Water hardness; softening of water by classical methods, Ion-exchange, Demineralization, Reverse osmosis and Distillation; Boiler Scaling, types, effects and mechanism; Removal of Boiler scales, Physical and Chemical methods.

**2. Soaps, Detergents And Disinfectants:**

Soaps – Introduction, types, raw materials, counter-current method for soap manufacturing, recovery glycerin from spent lye and sweet water, builders and Additives.

Detergents – Introduction, theory and working of detergents, cationic, anionic and non-ionic and amphoteric detergents, synthesis of typical anionic detergents, fabric softener (introduction and mechanism of action), Environmental impact of detergents.

Disinfectants – Introduction, types and applications.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Water Supply and Sewerage, T.J.McGhee, McGraw Hill Book Co. New York.(1991)
3. Hand Book of Industrial Chemicals, By SIRI Board of Consultants and Engineers,
4. Shereve's Chemical Process Industries, 5th Ed.1975 by G.T.Austin McGraw Hill Book Co. New York.
5. Industrial chemistry, B. K. Sharma Krishna Prakashan Media (P) Ltd., Ed-15 (2006)

**APPLIED CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-332</b>
<b>Module title:</b>	<b>Unit Processes &amp; Chemicals</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6th Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will help the students in assessing the Unit processes in Organic Industries. The students will learn about the basic raw materials and their applications in chemical industries.

**SYLLABUS OUTLINE:**

1. **Unit Processes in Organic Synthesis:**  
Introduction, agents, mechanism, general procedure and application of Nitration; Halogenation; Sulphonation; Esterification and Oxidation.
2. **Basic Industrial Raw Materials:**  
Origin/Source, Properties, Chemistry and industrial applications of Acetylene, propylene, Ethylene, BTX, Naphthalene, Butadiene and Styrene.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Shereve's Chemical Process Industries, 5th Ed.1975 by G.T.Austin, McGraw Hill Book Co. New York.
3. Industrial Organic Chemicals, by H.A.Witcoff and B.J.Reuben, John Wiley & Sons Inc. New York.
4. Riegel's handbook of Industrial Chemistry, Ed. J.A.Kent, CBS Publishers and Distributors, New Delhi (1997).
5. Chemical Process Design, Robin Smith, McGraw Hill Book Co. New York. (1995).
6. Hand Book of Industrial Chemicals, by SIRI Board of Consultants and Engineers, Small Industries Research Institute, New Delhi (1995).
7. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).

**APPLIED CHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-333</b>
<b>Module Title:</b>	<b>Applied Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

It will the students to increase their working skills in labs, theory and working of Flamephotometry.

**SYLLABUS OUTLINE:**

- Preparations:**  
Dentifrice, Thermo and Thermosetting polymers
- Titrimetry:**  
Estimation of Residual and Available Chlorine  
Acidity of Vinegar  
Acidity of Sulphuric acid  
Analysis of Soap (Free and Combined alkalinity)
- Flamephotometry:**  
Determination of the Sodium in water  
Determination of Potassium in water  
Simultaneous determination of sodium and potassium in water

**RECOMMENDED BOOKS:**

- Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
- Water Supply and Sewerage, T.J.McGhee, McGraw Hill Book Co. New York.(1991)
- Hand Book of Industrial Chemicals, By SIRI Board of Consultants and Engineers,
- Shereve's Chemical Process Industries, 5th Ed.1975 by G.T.Austin McGraw Hill Book Co. New York.
- Industrial chemistry, B. K. Sharma Krishna Prakashan Media (P) Ltd., Ed-15 (2006)

**BIOCHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-334</b>
<b>Module title:</b>	<b>Proteins</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

After studying this course, students will be able to understand classification, properties and importance of amino acids. Students will also learn Structural classification and biological importance of proteins, dietary proteins and their digestion. It will also help to learn general pathways of amino acid catabolism and metabolism.

**SYLLABUS OUTLINES**

Amino acids: Structure, Chiral Center, stereoisomerism and optical activity. Classification of amino acids; chemical, nutritional, metabolic and R group. Acid base properties of amino acids, their titration curves and importance of titration curves. Biological significance of amino acids and peptides. Proteins: Covalent structure, classification, and biological significance of proteins including Primary, Secondary, Tertiary and Quaternary structure of proteins, as Keratins, Collagens and elastin. Conformation, structure and function of Fibrous and globular proteins with special reference to Hemoglobin and Myoglobin. Digestion and Absorption of Proteins. Biosynthesis of essential amino acids and their degradation. Urea Cycle, decarboxylation, transamination and deamination reactions of amino acids and their importance. Synthesis and secretion of creatine and creatinine.

**RECOMMENDED BOOKS:**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000  
Pub: worth Publishers
2. Biochemistry by Lubert Stryer(2006) Pub: Freeman and Company
3. Harpers Biochemistry, 27<sup>th</sup> ed. (2006) McGraw Hill Inc.
4. Lippincott's Biochemistry by champ c; Harvey.R.A and Ferrie. D .R. 3<sup>rd</sup> edition., Pub: J. B. Lippincott company

**BIOCHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-335</b>
<b>Module title:</b>	<b>Nutrition</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6th Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

After studying this course student will be able to understand Importance of nutrition and Basal Metabolic Rate measurement. Students will also learn basics of Physiological function and requirement of micro and macro minerals. In addition, it will also help in better understanding of Vitamins, its types, physiological function, deficiency symptoms, and daily dietary requirements.

**SYLLABUS OUTLINE:**

Introduction and importance the science of nutrition: Brief introduction of nutrients, classification of nutrients and their Importance, Importance physiological function and requirement of micro and macro minerals for life and their deficiency symptoms. Introduction and history of vitamins. Classification of vitamins. A discussion of the occurrence, Chemistry, Physiological function, deficiency symptoms, and requirements of Vitamins A, B-Complex, C, D, E and K. Energy value and requirement of food under different living and physiological conditions. Basal metabolic rate (BMR), respiratory quotient and their measurements. Energy expenditure and its importance for health. Direct and Indirect calorimetry methods for the determination of energy expenditure. Thermogenic effect of food and Nutrition status of food in Pakistan.

**RECOMMENDED BOOKS:**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000 Pub: worth Publishers
2. Biochemistry by Lubert Stryer (2006) Pub: Freeman and Company
3. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.
4. Advanced Nutrition and Human Metabolism - 6th Edition

**BIOCHEMISTRY (BS-ADP 6<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-336</b>
<b>Module title:</b>	<b>Bio Chemistry Lab</b>
<b>Name of Scheme:</b>	<b>BS-ADP 6th Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Optional</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

This study will help students in understanding of practical grounds of different estimation tests of amino acids and proteins. It will also help in hydrolysis of proteins by various methods. Students will also be able to estimate different vitamins in food by chemical methods.

**SYLLABUS OUTLINE:**

- Qualitative tests and Quantitative tests of amino acids and proteins.
- Determination of isoelectric point.
- Isolation and solubilization of proteins from plant and animal origin.
- Hydrolysis and estimation of proteins by Kjeldahl and Lowry method.
- Estimation of Vitamin A, B1, B2, C and D in food materials by chemical methods and HPLC.
- Separation of different proteins in serum by Polyacrylamide gel electrophoresis (PAGE).

**RECOMMENDED BOOKS:**

1. Practical clinical Biochemistry by Varley. Pub: CBSpublisher
2. An Introduction to Practical Biochemistry By D. T. Plummer 3rd ed. (1987) Pub: Mc GrawHill
3. Varleys Practical Clinical Biochemistry 6<sup>th</sup> Edition (English, Hardcover, Alan H. Gowenlock)



**PHYSICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-401</b>
<b>Module title:</b>	<b>Colloids</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will acquire knowledge and understanding about the theoretical as well as application related aspects of various types of colloids and surfactants.

**SYLLABUS OUTLINES**

Colloids, Colloidal dispersions, sols and their preparation, properties of suspensions, Optional properties of sols, determination of particle size, kinetic properties of sols, sedimentation of suspensions, electrical properties of sols, electrophoresis and electro osmosis, stability of suspensions, precipitation of sols, associated colloids, macromolecular properties in solutions and molecular weight determinations.

Classification, Preparation and Characterization of emulsions, Emulsifiers and their properties, Gibbs surface excess, Micellization, Theories of emulsion type; Orientation wedge theory, kinetic theory. Emulsification and wetting, Stability of emulsions. Classification and properties of gels.

**RECOMMENDED BOOKS**

1. Physical Chemistry by Kundu, N and Jain, S.K.S. Chand and Company Ltd. 1984.
2. Fundamentals of chemical kinetics by Logan, S.R, Longman Group Ltd. 1996.
3. Elementary reaction kinetics by Latham.J.L. And Burgess, A.E.3rd Ed., Butterworths, London, 1977.
4. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House, (2014).
5. Physical chemistry by Atkins, P.W. 5th Ed., W.H.Freeman and Company, New York, 1994.
6. Physical Chemistry by Alberty, R.A. and Silbey. R.J., John Wiley, New York, 1995.
7. Physical chemistry by Engel, T. and Ried, P., 1st Ed., Pearson Education, Inc. 2006.
8. Hand book of surface and Colloid Chemistry by Birdi, K.S., CRC Press, 1997.
9. Heterogeneous Catalysis: Principles and applications by Bond, G.C., 2nd Ed., Oxford, Clarendon press, 1987.
10. Surfactants and interfacial Phenomena by Rosen, Milton J., John Wiley, New York, 1978.

**PHYSICAL CHEMISTRY (BS-ADP 7<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-402</b>
<b>Module title:</b>	<b>Physical Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

Students will be trained to carry out laboratory work using various techniques including filtration, solvent extraction, spectrophotometric and conducto-metric methodologies.

**SYLLABUS OUTLINES**

1. Verification of Freundlich adsorption isotherm for Adsorption of acetic acid on active charcoal.
2. Determination of Critical micelle concentration of various ionic surfactants in water.
3. Determination of the partition coefficient of benzoic acid between organic solvent and water.
4. Determination of the partition coefficient of iodine between CCl<sub>4</sub> and H<sub>2</sub>O.
5. Preparation of silver sol and its characterization by UV Visible spectroscopy.

**RECOMMENDED BOOKS**

1. Advanced Experimental Physical Chemistry by Ayodhya Sing.
2. Experimental Physical Chemistry by Daniel
3. Experimental Physical Chemistry by G.Peter Matthews.
4. Experiments in Physical Chemistry by Shoemaker.

**PHYSICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-403</b>
<b>Module title:</b>	<b>Surface Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will acquire knowledge and understanding about the theoretical as well as application related aspects of surface chemistry. They will be able to explore adsorption and catalysis processes including autocatalysis and enzyme catalysis.

**SYLLABUS OUTLINES**

Adsorption, types of adsorption, Adsorption isotherms, single system, double system, catalytic reaction of a gas on solid surface, catalytic reaction of two gases on solid surface, the Eley-Rideal mechanism and the Langmuir-Hinshelwood mechanism, Autocatalysis, enzyme catalysis and enzyme inhibition.

**RECOMMENDED BOOKS**

1. Physical Chemistry by Kundu, N and Jain, S.K.S. Chand and Company Ltd. 1984.
2. Fundamentals of chemical kinetics by Logan, S.R, Longman Group Ltd. 1996.
3. Elementary reaction kinetics by Latham.J.L. And Burgess, A.E.3rd Ed., Butterworths, London, 1977.
4. Physical chemistry by Atkins, P.W. 5th Ed., W.H.Freeman and Company, New York, 1994.
5. Physical Chemistry by Alberty, R.A. and Silbey. R.J., John Wiley, New York, 1995.
6. Physical chemistry by Engel, T. and Ried, P., 1st Ed., Pearson Education, Inc. 2006.
7. Hand book of surface and Colloid Chemistry by Birdi, K.S., CRC Press, 1997.
8. Heterogeneous Catalysis: Principles and applications by Bond, G.C., 2nd Ed., Oxford, Clarendon press, 1987.
9. Surfactants and interfacial Phenomena by Rosen, Milton J., John Wiley, New York, 1978.
10. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House, (2014).

**PHYSICAL CHEMISTRY (BS-ADP 7<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-404</b>
<b>Module title:</b>	<b>Physical Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

Students will be able to learn spectrophotometric, potentiometric and polarimetric techniques and their use in various applications.

**SYLLABUS OUTLINES**

1. Determination of percentage composition of two coloured components in solution spectrophotometrically.
2. Study of kinetics of iodination of acetone using UV Visible Spectrophotometry.
3. Determination of concentration of HCl using standard solution of NaOH by potentiometric method.
4. Study of kinetics of inversion of cane sugar using polarimetry.
5. Study of kinetics of decomposition of benzene diazonium chloride.

**RECOMMENDED BOOKS**

1. Advanced Experimental Physical Chemistry by Ayodhya Sing.
2. Experimental Physical Chemistry by Daniel
3. Experimental Physical Chemistry by G.Peter Matthews.
4. Experiments in Physical Chemistry by Shoemaker.

**PHYSICAL CHEMISTRY (BS-ADP 7<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-405</b>
<b>Module title:</b>	<b>Molecular Spectroscopy</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will be able to learn fundamentals and applications of both vibrational and rotational spectroscopy. They will be able to analyze IR spectra of various organic molecules.

**SYLLABUS OUTLINES**

Special regions and classification of spectroscopy; Rotational energies of diatomic molecules, population of Rotational energy level. Rotational spectra of rigid linear molecules and determination of bond lengths. The Zeeman Effect and Stark effect in atom.

Vibrational spectroscopy: energy of an atomic molecule, harmonic and harmonic oscillator molecules, relative population of energy levels and intensities of transition, types of vibrational modes.

Vibrational of polyatomic molecules, interpretation of IR spectra of simple molecules, Fermi resonance, applications and sampling techniques.

**RECOMMENDED BOOKS**

1. Physical Chemistry by Kundu, N and Jain, S.K.S. Chand and Company Ltd. 1984.
2. Fundamentals of chemical kinetics by Logan, S.R, Longman Group Ltd. 1996.
3. Elementary reaction kinetics by Latham.J.L. And Burgess, A.E.3rd Ed., Butterworths, London, 1977.
4. Physical chemistry by Atkins, P.W. 5th Ed., W.H.Freeman and Company, New York, 1994.
5. Physical Chemistry by Alberty, R.A. and Silbey. R.J., John Wiley, New York, 1995.
6. Physical chemistry by Engel, T. and Ried, P., 1st Ed., Pearson Education, Inc. 2006.
7. Hand book of surface and Colloid Chemistry by Birdi, K.S., CRC Press, 1997.
8. Heterogeneous Catalysis: Principles and applications by Bond, G.C., 2nd Ed., Oxford, Clarendon press, 1987.
9. Surfactants and interfacial Phenomena by Rosen, Milton J., John Wiley, New York, 1978.

**PHYSICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-406</b>
<b>Module title:</b>	<b>Physical Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

This lab course will be highly helpful for students to learn about optical activity of organic compounds, analysis of IR spectra of simple organic molecules and use of refractive index for different purposes.

**SYLLABUS OUTLINES**

1. Predicting normal modes of vibration for simple molecules and interpretation of their IR Spectra.
2. Determination of specific rotation and molar rotation of optically active substances (sucrose and glucose).
3. Determination of wavelength of maximum absorption of various colored substances.
4. Determination of Dissociation Constant of an Acid by Spectrophotometric Method.
5. Determination of specific refraction and molar refraction of binary solutions.

**RECOMMENDED BOOKS**

1. Advanced Experimental Physical Chemistry by Ayodhya Sing.
2. Experimental Physical Chemistry by Daniel
3. Experimental Physical Chemistry by G.Peter Matthews.
4. Experiments in Physical Chemistry by Shoemaker.

**PHYSICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-407</b>
<b>Module title:</b>	<b>Solution Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will be helpful for students for their learning in fundamentals of solution chemistry.

**SYLLABUS OUTLINES**

The thermodynamic properties of solution. The solution process. Conditions of equilibrium between phases. Theoretical basis of Raoult's equation. Deviation from ideal behavior. Compound formation and association. Separation of solid solutions. Semi Permeable membranes. The cause of semi-permeability. Mechanism of osmotic pressure. Dilute solutions and the Gas Laws. The Bombardment theory. Objections to the Bombardment theory. Review of the theories. Determination of the molecular weight by Osmometry.

**RECOMMENDED BOOKS**

1. Physical Chemistry by Kundu, N and Jain, S.K.S. Chand and Company Ltd. 1984.
2. Physical chemistry by Atkins, P.W. 5th Ed., W.H. Freeman and Company, New York, 1994.
3. Physical Chemistry by Alberty, R.A. and Silbey. R.J., John Wiley, New York, 1995.
4. Physical chemistry by Engel, T. and Ried, P., 1st Ed., Pearson Education, Inc. 2006.
5. Physical Chemistry, Samuel Glasstone, 1995. Macmillan and Co. Ltd. St. marlins Street, London.
6. Principles of Physical chemistry, Maron and Prutton, 1965 the Macmillan Company, Collier Macmillan Ltd. London.
7. Physical Chemistry, Barrow, 1973, McGraw Hill, Tokyo.

**INORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-408</b>
<b>Module title:</b>	<b>Periodicity</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

The aim of this course is to provide the concepts for better understanding of advance study in inorganic chemistry and other interdisciplinary subject related to inorganic chemistry. The students will learn about stereochemistry and bonding in main group compounds, periodicity and organic reagents used in inorganic analysis.

**SYLLABUS OUTLINE:**

- 1. Periodicity of s-Block block elements:**  
Introduction, Occurrence and Abundance, Extraction of these metals, Flame colours and spectra, Chemical Properties, Oxides, hydroxides, Sulfides, Hydrides, Oxosalts, Nitrates, Carbides, Halide, Biological importance.
- 2. Periodicity of p-Block block elements:**  
Introduction, Occurrence and Abundance, First and second row anomalies. The use of d-orbitals by non-metals, reactivity and d-orbital participation. The use of p-orbitals in Pi-bonding, periodic anomalies of the non-metals and post-transition metals,  $d\pi$ - $P\pi$  bonds.

**RECOMMENDED BOOKS:**

1. Quantitative Analysis Chemistry, James S. Pritz, George H. Schenk, 1987 Alby and Becon Inc. London.
2. Inorganic Chemistry by James E. Huheey 1983 Harper International London.
3. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkineon 1972, Interscience, Publishers, London.
4. Haq Nawaz Bhatti and Rabia Rehman, Advanced Inorganic Chemistry”, Carvan Book House Lahore.
5. R.D.Madan, Satya Prakash’s Modern Inorganic Chemistry, S. Chand Company and Ltd, 2002.



**INORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-409</b>
<b>Module title:</b>	<b>Inorganic Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The aim of this course is to interpret the concepts for better understanding in inorganic chemistry. This course will familiarize the students, use of organic reagents for the estimation of various cations and anions.

**SYLLABUS OUTLINE:**

**1. Use of organic reagents for the estimation of various ions;**

**(At least any four of the following):**

- (a)** 8-Hydroxyquinoline ( $\text{Al}^{3+}$ ,  $\text{Ti}^{3+}$ ,  $\text{Fe}^{3+}$ )
- (b)** Pyrogallol ( $\text{Bi}^{3+}$ )
- (c)** Nitron ( $\text{NO}_3^{-1}$ )
- (d)** Salicyladoxime ( $\text{Ni}^{2+}$  in presence of  $\text{Cu}^{2+}$ )
- (e)** Anthranilic acid ( $\text{Cd}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Co}^{2+}$ )

**RECOMMENDED BOOKS:**

1. Vogel, Arthur I. A Text-Book Of Quantitative Inorganic Analysis-Theory And Practice. Longmans, Green And Co.; London; New York; Toronto, 2013.
2. Rabia Rehman and Haq Nawaz Bhatti, "Experimental Inorganic Chemistry", Carvan Book House Lahore in 2015.
3. Haq Nawaz Bhatti and Rabia Rehman "Advanced Experimental Inorganic Chemistry" Carvan Book House Lahore in 2017.
4. Mendham, John. Vogels textbook of quantitative chemical analysis. Pearson Education India, 2006.

**INORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-410</b>
<b>Module title:</b>	<b>Reagents and Solvents</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

The aim of this course is to provide the concepts for better understanding of advance study in inorganic chemistry and other interdisciplinary subject related to inorganic chemistry. The students will learn about stereochemistry and bonding in main group compounds, periodicity and organic reagents used in inorganic analysis.

**SYLLABUS OUTLINE:**

**1. Organic Reagents:**

Classification of organic reagents, their selectivity and specificity, methods of preparation of specific compounds and their studies with UV, Visible and IR. Typical reagents used in complexometric titrations involving the use of EDTA. Chelates, classification, stability, preparation and properties. Role of organic Reagents in different analytical techniques.

**2. Aqueous and non-aqueous solvents:**

Classification of solvents, types of reactions, the dielectric constant, solubilities, electrode potential and electromotive forces. Reactions in water and molten salts. Reactions in non-aqueous solvents, i.e. ammonia, sulfur dioxide, bromine trifluoride and hydrofluoric acid.

**RECOMMENDED BOOKS:**

1. Hand Book of Organic reagents in Inorganic Analysis by ZAVIX Holzbecher and other 1976 Ellis Hurwod Limited, London.
2. Vogel, Arthur I. A Text-Book Of Quantitative Inorganic Analysis-Theory And Practice. Longmans, Green And Co.; London; New York; Toronto, 2013.
3. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkineon 1972, Interscience, Publishers, London.
4. Haq Nawaz Bhatti and Rabia Rehman, Advanced Inorganic Chemistry”, Carvan Book House Lahore.
5. Sisler, H.H. 1965. Chemistry in Non-Aqueous Solvents. Chapman & Hall Ltd.
6. House, J.E. 2010. Inorganic Chemistry. Academic Press, USA.

**INORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-411</b>
<b>Module title:</b>	<b>Inorganic Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The aim of this course is to interpret the concepts for better understanding in inorganic chemistry. This course will familiarize the students use of organic reagents for the estimation of various metal ions, instrumental methods of analysis.

**SYLLABUS OUTLINE:**

**1. Instrumental methods of analysis:**

**Colorimetry:**

- i). Micro determination of chromium by diphenylCarbazide.
- ii). Determination of iron(II) by 1, 10 Phenanthroline.
- iii). Determination of nickel (II) by DMG
- iv). Determination of Pb (II) by Dithizone.

**RECOMMENDED BOOKS:**

1. Vogel, Arthur I. A Text-Book Of Quantitative Inorganic Analysis-Theory And Practice. Longmans, Green And Co.; London; New York; Toronto, 2013.
2. Rabia Rehman and Haq Nawaz Bhatti, "Experimental Inorganic Chemistry", Carvan Book House Lahore in 2015.
3. Haq Nawaz Bhatti and Rabia Rehman "Advanced Experimental Inorganic Chemistry" Carvan Book House Lahore in 2017.
4. Mendham, John. Vogels textbook of quantitative chemical analysis. Pearson Education India, 2006.

**INORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-412</b>
<b>Module title:</b>	<b>Kinetic &amp; Thermodynamic</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

The aim of this course is to provide the concepts for better understanding of advance study in inorganic chemistry and other interdisciplinary subject related to inorganic chemistry. The students will learn about kinetics and mechanisms of reaction of coordination compounds, reactions in aqueous and non-aqueous solvents and radioactivity.

**SYLLABUS OUTLINE:**

**1. Kinetic aspects**

Introduction of reaction rate law and mechanism of stationary state approximation. Type of reactions, nucleophilic displacements, effective collisions. Dis-placement in square planar complexes, trans-effect, replacement in octahedral complexes, inert and labile complexes, (VBT, CFT explanation), Inner and outer sphere exchange reactions.

**2. Thermodynamic aspects:**

Thermodynamic and kinetic stability, Interpretation of stability, Role of thermodynamics in interpretative chemistry, The lattice energy as a criterion of bond type, Quantitative uses of the lattice energy, The Kapustunskii equations, The stabilization of high oxidation states by fluorine and oxygen, The stabilization of low oxidation states by large anions, Halogen exchange reaction, The stability of halides containing protonated bases.

**RECOMMENDED BOOKS:**

1. Coordination Chemistry by B.A. Basallo and R. Johnson 1972 W.A. Benhamen, London.
2. Haq Nawaz Bhatti and Rabia Rehman, "Advanced Inorganic Chemistry", Carvan Book House Lahore.
3. Some Thermodynamic Aspects of Inorganic Chemistry By David Arthur Johnson.
4. Chemical thermodynamics: with special reference to inorganic chemistry by David J. G. Ives.

**INORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-413</b>
<b>Module title:</b>	<b>Inorganic chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The aim of this course is to interpret the concepts for better understanding in inorganic chemistry. This course will familiarize the students use of organic reagents for the estimation of various metal ions, instrumental methods of analysis. This student will also learn about the identify acid and basic radicals of given salt by chemical analysis.

**SYLLABUS OUTLINE:**

**1. Salt Analysis:**

Identify acid and basic radicals of given salt by chemical analysis.

**2. Chromatographic Techniques**

- a) Separation of metal ions by paper chromatography and their identification with the help of locating agents and comparison of  $R_f$  values.
- b) Separation of anions by paper chromatography and their identification.

**RECOMMENDED BOOKS:**

1. Vogel, Arthur I. A Text-Book Of Quantitative Inorganic Analysis-Theory And Practice. Longmans, Green And Co.; London; New York; Toronto, 2013.
2. Rabia Rehman and Haq Nawaz Bhatti, "Experimental Inorganic Chemistry", Carvan Book House Lahore in 2015.
3. Haq Nawaz Bhatti and Rabia Rehman "Advanced Experimental Inorganic Chemistry" Carvan Book House Lahore in 2017.
4. Mendham, John. Vogels textbook of quantitative chemical analysis. Pearson Education India, 2006.

**INORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-414</b>
<b>Module title:</b>	<b>Environmental Aspects</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

The aim of this course is to provide the concepts for better understanding of advance study in inorganic chemistry and other interdisciplinary subject related to inorganic chemistry. The students will learn about stereochemistry and bonding in main group compounds, periodicity and organic reagents used in inorganic analysis.

**SYLLABUS OUTLINE:**

**1. Environmental aspects of inorganic compounds:**

Introduction, environmental segments and their interrelation ships (Water Cycle, Oxygen Cycle, Nitrogen Cycle), Environmental quality standards (air, drinking water and wastewater), nature and composition of atmosphere,, common air pollutants and their sources, greenhouse effect and global warming, stratospheric ozone depletion, vehicular emissions, Acid rain and its impacts, Photochemical smog, Indoor air quality. Importance of water, criteria for water quality, BOD and COD, sources of water pollution (industrial, agricultural, municipal and natural), fertilizers, pesticides, detergents, heavy metals, bio-accumulation and bio-amplification, primary, secondary and advanced treatment of water.

**RECOMMENDED BOOKS:**

1. J.W. Moore & EM. Moore, Environmental Chemistry, Academic Press, New York.
2. Manahan, S. (2017). Environmental chemistry. CRC press.
3. Sharma, B. K. (2014). Environmental chemistry. Krishna Prakashan Media.

**ORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-415</b>
<b>Module title:</b>	<b>Reaction Mechanism-II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

To get ideas about the development of mechanisms and basic principles working behind different types of molecular rearrangement based reactions of organic compounds.

**SYLLABUS OUTLINES:**

**1. Molecular Rearrangements**

Classification of molecular rearrangements: mechanism of intramolecular 1,2-shifts involving migration of a group from carbon to carbon, carbon to nitrogen, and carbon to oxygen, mechanism and synthetic applications of Wagner-Meerwein, Pinacol-pinacolone, benzylic acid, Favorski, Wolff, Beckmann, Hoffmann, Curtius, Lossen and Schmidt; Baeyer-Villiger, Dakin and Fries rearrangements.

**2. Determination of Reaction Mechanism**

Determination of reaction mechanism, kinetics, stereochemical, intermediate formation, spectroscopic and isotopic labeling methods.

**RECOMMENDED BOOKS:**

1. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
2. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
3. A Text-Book of Organic Chemistry by M. Younas, ILMI, Pakistan.
4. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
6. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and r.K. Boyd, Benjamin Cummings, 1992.
7. Modern Synthetic Reactions, (2<sup>nd</sup> Ed.) by H.O. House, W.A. Benjamin Inc., Menlo Park, CA.
8. Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.
9. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

**ORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-416</b>
<b>Module title:</b>	<b>Organic Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

To gain experimental skills for separation and identification of three components in a mixture of unknown compounds via systematic physical and chemical tests.

**SYLLABUS OUTLINES:**

**1. Qualitative analysis**

Three component organic mixture analysis (separation and identification of three unknown components). Recrystallization and Derivatizations

**RECOMMENDED BOOKS:**

1. The Systematic Identification of Organic Compounds (8<sup>th</sup> Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5<sup>th</sup> Ed.) by A.I. Vogel et al. Longman, UK, 1989.
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. Advanced Practical Organic Chemistry (2<sup>nd</sup> Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.



**ORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-417</b>
<b>Module title:</b>	<b>Oxidation &amp; Reduction</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

To achieve knowledge about the mechanisms and principles operative in different types of methods for oxidation and reduction of organic compounds.

**SYLLABUS OUTLINES:**

**1. Oxidation Reactions**

Introduction, oxidation of saturated hydrocarbons, olefinic double bonds, aromatic rings, systems containing oxygen such as phenols, alcohols, aldehydes, ketones, and dicarbonyl compounds, oxidative decarboxylation, of acids, oxidation of systems containing nitrogen such as amines, hydrazines and hydrazones.

**2. Reduction Reactions**

Introduction, reduction of cycloalkanes, alkenes, alkynes, and aromatic rings, hydrogenolysis, reduction of benzylic and allylic systems, aldehydes and ketones, alcohols, pinacols, epoxides, acids and their derivatives, Reduction of system containing nitrogen such as imines, oximes and nitro compounds.

**RECOMMENDED BOOKS:**

1. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
2. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
3. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
4. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and r.K. Boyd, Benjamin Cummings, 1992.
6. Modern Synthetic Reactions, (2<sup>nd</sup> Ed.) by H.O. House, W.A. Benjamin Inc., Menlo Park, CA.
7. Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.
8. Heterocyclic Chemistry, (4<sup>th</sup> Ed.), by J.A. Joules, K. Mills, Blackwell Publishing, 2000.
9. Heterocyclic Chemistry, (3<sup>rd</sup> Ed.), by T.L. Gilchrist, Longman, 1997.
10. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

**ORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-418</b>
<b>Module title:</b>	<b>Organic Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

To gain experimental skills for separation, purification by chromatography (TLC, etc) and analysis of different organic compounds by spectroscopy (UV, IR).

**SYLLABUS OUTLINES:**

**1. Chromatography and Spectroscopy**

Separation of mixtures of different organic compounds and isomers (Nitroanilines, bromoanilines, nitro and bromophenols etc) by silica chromatography and identification by spectroscopy (UV-Vis. IR etc).

**RECOMMENDED BOOKS:**

1. The Systematic Identification of Organic Compounds (8<sup>th</sup> Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5<sup>th</sup> Ed.) by A.I. Vogel et al. Longman, UK, 1989.
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. Advanced Practical Organic Chemistry (2<sup>nd</sup> Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.

**ORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-419</b>
<b>Module title:</b>	<b>Reaction Mechanism-III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

To grasp ideas about the mechanisms, basic rules and principles working behind different types of nucleophilic substitutions and elimination reactions.

**SYLLABUS OUTLINES:**

**1. Aliphatic Nucleophilic Substitutions**

Mechanism of  $S_N1$ ,  $S_N2$ ,  $S_{Ni}$ ,  $S_{N1'}$ ,  $S_{N2'}$  and  $S_{Ni'}$  reactions, kinetics, stereochemical and other evidence; effects of other substrate structure, attacking nucleophile, leaving group and solvent; neighboring group participation (Anchimeric assistance).

**2. Elimination Reactions**

Mechanism of  $E_1$ ,  $E_2$ , and  $E_{1cB}$  elimination reactions; kinetics and stereochemical studies; applications of thermodynamically and kinetically controlled reactions (Saytzeff and Hoffmann reactions), Effects of substrates, solvent, base, leaving group and temperature on kinetics, competition between elimination and substitution reactions. Pyrolytic eliminations.

**RECOMMENDED BOOKS:**

1. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
2. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
3. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
4. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and r.K. Boyd, Benjamin Cummings, 1992.
6. Modern Synthetic Reactions, (2<sup>nd</sup> Ed.) by H.O. House, W.A. Benjamin Inc., Menlo Park, CA.
7. Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.
8. Heterocyclic Chemistry, (4<sup>th</sup> Ed.), by J.A. Joules, K. Mills, Blackwell Publishing, 2000.
9. Heterocyclic Chemistry, (3<sup>rd</sup> Ed.), by T.L. Gilchrist, Longman, 1997.
10. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

**ORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-420</b>
<b>Module title:</b>	<b>Organic Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

To gain experimental skills for different organic transformations, workups, separation and identification of products obtained in a multistep synthesis.

**SYLLABUS OUTLINES:**

**1. Multistep Organic Preparations**

Conversion of carboxylic acid to ester, its reduction to alcohol; Conversion of alcohol to alkyl halide and carbonyl compounds; Protection and deprotections; Aniline to 4-nitro- and 4-bromoanilines *via* acetanilide etc

**RECOMMENDED BOOKS:**

1. The Systematic Identification of Organic Compounds (8<sup>th</sup> Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5<sup>th</sup> Ed.) by A.I. Vogel et al. Longman, UK, 1989.
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. Advanced Practical Organic Chemistry (2<sup>nd</sup> Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.

**ORGANIC CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-421</b>
<b>Module title:</b>	<b>NMR Spectroscopy</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**SYLLABUS OUTLINES:**

**1. Nuclear Magnetic Resonance (NMR) Spectroscopy**

NMR: Basic principles, theory, spin flipping, nuclear precession and absorption of electromagnetic radiation, spin relaxation, basic introduction of 1-D (<sup>1</sup>H and <sup>13</sup>C) NMR spectroscopy, chemical shifts and integration curve, instrumentation, spin-spin splitting and coupling constants. Structure elucidation of small and substituted aromatic compounds.

**RECOMMENDED BOOKS:**

1. Organic Spectroscopy and Chromatography, by M. Younas. Ilmi kitab khana, kabir street, urdu bazar, Lahore.
2. Organic Chemistry, (4<sup>th</sup>-7<sup>th</sup> Ed) by Paula Yurkanis Bruice, Pearson Education (Singapore) Pvt. Ltd. 2004-2015.
3. Introduction to Spectroscopy by Donald L. Pavia, Gary M. Lampman, George S. Kriz, (2<sup>nd</sup> – 5<sup>th</sup> Ed). Saunders Golden Sunburst Series, 1996-2018.
4. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
5. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
6. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
7. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.
8. Basic One and Two-Dimensional NMR Spectroscopy by Jack K. Beconsall (4<sup>th</sup> Ed). Wiley-VCH verlag GmbH & Co. KGaA, 2005.

**ANALYTICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-422</b>
<b>Module title:</b>	<b>ElectroanalysisMethod-I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

This course deals with the advanced chromatographic techniques like HPLC and GC. The students will learn about the instrumentation, applications and the sensitivities etc of these techniques. Furthermore, basic principle and applications of Potentiometry along with the various electrodes will be studied. The role of thermal methods in the analysis of various samples will be studied.

**SYLLABUS OUTLINE:**

- Potentiometry:**  
Nernst equation; Electrode Potentials; different reference electrodes including glass and calomel electrode; working of a potentiometer and its applications including pH measurements and potentiometric titrations; ion-selective electrode systems; ion-exchange membrane electrode; gas-sensing electrode; solid-state membrane electrode and bio membrane electrode.
- Conductometry:**  
Conductance in Solutions; Specific conductance; molar conductance; factors upon which the conductance of solution depends; Measurement of conductance/Instrumentation; cell constant; Analytical applications of conductance measurement.

**RECOMMENDED BOOKS:**

1. Electro Analytical Chemistry by J.J. Longane, Inter Science Publisher Inc. N.Y. London.
2. Vogels, text book of Quantitative chemical analysis by J. Mendham, R.C. Denney, J.D. Barnes, M.J. Thomas, Pearson Education Ltd.

**ANALYTICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-423</b>
<b>Module title:</b>	<b>Analytical Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

This course will be helpful to students in understanding electroanalytical techniques. Its basic and advance applications in aqueous and non aqueous titrations.

**SYLLABUS OUTLINE:**

**1. Conductometry:**

Determine the amount of HCl conductometrically by using strong base NaOH.  
Determine the amount of base NH<sub>4</sub>OH conductometrically by using strong acid.  
Determine the amount of NH<sub>4</sub>OH by using weak acid CH<sub>3</sub>COOH conductometrically.  
Determine the amount of NaOH conductometrically by using weak acid CH<sub>3</sub>COOH.

**2. Potentiometry:**

Determine the amount of HCl by using strong base (NaOH) potentiometrically.  
Determine the amount of HCl by using weak base (NH<sub>4</sub>OH) potentiometrically.  
Determine the amount of CH<sub>3</sub>COOH by using strong base (NaOH).  
Determine the amount of HCl & CH<sub>3</sub>COOH conductometrically by using strong base NaOH.  
Simple acid base titrations using potentiometer.  
Determination of "F" in water by using ion selective electrodes.

**RECOMMENDED BOOKS:**

1. Vogels, text book of Quantitative chemical analysis by J.mendham, RCDenny, JDBarnes, MJ KTHomas, Pearson education Ltd.

**ANALYTICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-424</b>
<b>Module title:</b>	<b>Atomic Spectroscopy</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

In this course, the students will be able to learn about Atomic emission, atomic absorption and atomic fluorescence spectroscopic techniques. Its application in advance analytical testing of organic and inorganic samples.

**SYLLABUS OUTLINE:**

**1. Atomic Emission / Atomic Fluorescence Spectroscopy:**

Basic principle of atomic emission spectroscopy; Source of atomization; Use of atomic spectra for detection and determination of elements; flame as a source of atomization and excitation; Instrumentation involved in FES; applications and limitations, Flame temperatures. Atomic Fluorescence Spectroscopy, Instrumentation, Applications, plasma sources and ICP-AES.

**2. Atomic Absorption Spectroscopy:**

Basic Principle of AAS; Flameless AA spectroscopy including graphite furnace and hydride generation. Interferences, Instrumentation and application and limitation.

**RECOMMENDED BOOKS:**

1. Chemical Application of Spectroscopy by West, Inter Science Publisher Inc. N.Y. London.
2. Kinetics in Analytical Chemistry by H.B. Mark Jr. & G.A. Rechnitz, Interscience N.Y. (1968).
3. Analytical Chemistry by Gary D. Christian, John Wiley and Sons (1977).
4. Automated Chemical Analysis by J.K. Forman Stockwell, John Wiley and Sons, N.Y. (1975).
5. Advances in Infrared Group Frequencies by L.J. Bellamy, Methuen & Co. Amsterdam (1968).
6. Fundamentals of Molecular Spectroscopy by Banwell.



**ANALYTICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-425</b>
<b>Module title:</b>	<b>Analytical Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

The students will be able to prepare the solutions of various concentrations. They will understand the use of atomic spectroscopic techniques for the practical determination of various elements in the given samples. They will also learn how to use the molecular spectroscopy and obtaining the valuable information.

**SYLLABUS OUTLINE:**

**1. Flame Emission / Spectrophotometry:**

Determination of Sodium in tap water by using Flame Photometer.  
Determination of Potassium in tap water by using Flame Photometer.  
Find out the calcium in chalk sample by flame photometry.  
Determination of Ba by flame photometry.  
Estimation of purity of various compounds on the base of flame emission Spectrophotometry.  
Indirect determination of various compounds by flame photometric techniques.

**2. Atomic Absorption/ Spectrophotometry:**

Determination of Fe, Pb, Cd, Zn and Cu in soil samples by AAS technique.  
Preparation of standard calibration graphs of Pb, Cd, Zn and Fe by AAS.

**RECOMMENDED BOOKS:**

1. Vogel's, s text book of quantitative inorganic analysis by J. Bassett. The English language book Society and Longman

**ANALYTICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-426</b>
<b>Module title:</b>	<b>Advance Chromatography</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7th Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

This course deals with the advanced chromatographic techniques like HPLC and GC. The students will learn about the instrumentation, applications and the sensitivities etc of these techniques. Furthermore, basic principle and applications of Potentiometry along with the various electrodes will be studied. The role of thermal methods in the analysis of various samples will be studied.

**SYLLABUS OUTLINE:**

1. **Gas Liquid Chromatography / Gas Solid Chromatography:**  
Gas Chromatographs, Derivative Formation, Gas Chromatographic Columns, Liquid Phases and Column Selection, Detectors for Gas Chromatography, Optimization of Experimental Condition, Gas-Solid Chromatography, Interfacing Gas Chromatography with Mass Spectrometry, Interfacing Gas Chromatography with Infrared Spectrometry,
2. **High Performance Liquid Chromatography:**  
Optimization of Column Performance, Gradient Elution and Related Procedures, Derivation, HPLC Instrumentation, Mobile-Phase Delivery System, Sample Introduction, Separation Columns, Detectors, Interfacing HPLC with Mass Spectrometry, Instrumentation, detectors, sensitivity, precision, sample types and qualitative and quantitative analysis.

**RECOMMENDED BOOKS:**

1. Electroanalytical chemistry by J.J. Longane, Inter Science Publisher Inc. N.Y. London..

**ANALYTICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-427</b>
<b>Module title:</b>	<b>Analytical Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

This course will help the students in hands on training on HPLC and Gas Chromatographic advance instrumentation. This course finds its application in various inorganic and organic samples analysis at trace levels.

**SYLLABUS OUTLINE:**

- Analysis of some drug samples (for example, Paracetamol and Caffeine) by HPLC.
- Determination of inorganic ions by HPLC.
- Isolation of compounds from plant extracts by HPLC.
- Gas Chromatographic MS Analysis of volatile samples
- Gas Chromatographic MS Analysis of vegetable oils

**RECOMMENDED BOOKS:**

1. Vogel's text book of quantitative inorganic analysis by J. Bassett. The English language book Society and Longman
2. Analytical Chemistry by G.D. Christian.

**ANALYTICAL CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-428</b>
<b>Module title:</b>	<b>Environmental Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7th Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

This course will help the students to learn the significance of environmental degradation, impact of the modern life use of acid value, ester value, saponification value and iodine value of different vegetable oils, dissolved oxygen, biological oxygen demand, chemical oxygen demand and industrial analysis. The student will also learn about industrial analysis and textile.

**SYLLABUS OUTLINE:**

**1. Analytical Techniques for pollutant Analysis**

Techniques for the analysis of emerging pollutants in aqueous system like PCB, PAH, THM, HAA.

Guidelines, Parameters, MCL and threshold values by US-EPA, ASTM, Pak-EPA.

**2. Environmental Pollution**

Introduction: Environmental pollution in the world and in Pakistan. Oxygen and ozone chemistry: Ozone depletion and its biochemical affect, sulfur dioxide, nitrogen oxide, chlorofluorocarbons, greenhouse effect. Hazards of pesticides: Hazards to man, soil, plant and animals. Water contamination through pesticides disposal, ground water contamination by herbicides. Effects of nitrogen fertilizer: Plant effluent discharges in soil, composition of fertilizer plant effluent discharges, effect and fate of nitrogen fertilizer effluent discharges in the soil ecosystem, suggestion for controlling adverse effects of fertilizer plant effluent and conservation of soil, leaching of fertilizer into soil, factors affecting nitrate, sulphate phosphate accumulation, losses of methane and ammonia from paddyland production system, global sources of methane, or sinks of methane. Atmospheric changes and sources of ammonia. Public awareness: Improper disposal/dumping of hazardous waste of landfills.

**RECOMMENDED BOOKS:**

1. Kumar. Environmental Chemistry, Wiley Eastern, New Delhi.
2. J.W. Moore & EM. Moore, Environmental Chemistry, Academic Press, New York.
3. S. K. Banerji, Environmental Chemistry, Prentice Hall, Delhi.
4. K. Banerji, Environmental Chemistry, Tata Publisher, Delhi.
5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.
6. Neil, P.O. Environmental Chemistry, Chapman, London.
7. Baird, C. Environmental Chemistry, Freeman, New York.
8. Hassol, K.A. 1992. Biochemistry of Pesticides. McMillan Publishing Co. Ltd. USA.
9. Kumar. 1987. Environmental Chemistry. Anmol Publication, New Dehli, India.
10. Evangelon, V. P. 1998. Environmental Soil and Water Chemistry. John Willey, USA.
11. McBride, M.B. 1994. Environmental Chemistry of Soils. Oxford University Press, UK.

**APPLIED CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-429</b>
<b>Module title:</b>	<b>Fuel Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

The students will learn about the existing energy resources; their processing, refining and utilization.

**SYLLABUS OUTLINE:**

1. **Processing of Crude Oil:**  
Brief description of origin of petroleum, Petroleum processing like Desalting, Fractional distillation; Refining, cracking; reforming, isomerization; alkylation and finishing processes (Doctor's Sweetening and Merox processes)
2. **Coal Chemicals & Fuel Gases:**  
The destructive distillation of coal, coking of coal distillation of coal tar; Liquid Fuels: Hydrogenolysis Natural gas; Coal Gas: Water Gas; Liquefied Petroleum Gases; LNG; Producer gas.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Petroleum Refining Technology, Ram Parsad (2002).
3. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).
4. Shereve's Chemical Process Industries, 5th Ed.1975, by G.T.Austin, McGraw Hill Book Co. New York.

**APPLIED CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-430</b>
<b>Module title:</b>	<b>Applied Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

It will increase the practical handling of fuels and their characterization. Also they will have some know how about the heavy metal load in industrial effluents.

**SYLLABUS OUTLINE:**

Determination of Diesel index, Aniline point and pour point of petroleum products  
Proximate analysis of Coal  
Heavy metal Analysis in Industrial Effluents

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Petroleum Refining Technology, Ram Parsad (2002).
3. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).
4. Shereve's Chemical Process Industries, 5th Ed.1975, by G.T.Austin, McGraw Hill Book Co. New York.

**APPLIED CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-431</b>
<b>Module title:</b>	<b>Steel &amp; Metal Finishing</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

The students will learn about the metallurgical operation regarding steel industry as well as classical and advance technologies to save iron from corrosion.

**SYLLABUS OUTLINE:**

1. **Steel Industry:**  
Steel – Mechanical properties of materials and change with respect to temperature, phase diagram of Fe-C system, manufacturing of steel, classification of steel, heat treatment of steel, important alloys of iron and their applications. Types of Corrosion and passivation techniques
2. **Metal Finishing Technology:**  
Introduction, need for surface treatment, different surface finishing processes, basics of electrodeposition, electroplating principles, electrochemistry applied to electroplating, mechanical preparation of surfaces - pickling, cleaning, rinsing, composition and conditions of plating bath, electroplating of metals-chromium, nickel, electroplating of plastics, electroplating waste treatment and metal recovery.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Chemistry of iron and Steel Manufacture, C. Bodsworth, Longman Press, London, 1963.
3. Graham's Electroplating Engineering Hand Book, Ed. L.J. Durney, CBS Publishers and Distributors, New Delhi. (1997).
4. Nickel and Chromium plating, J.K. Dennis & T.E. Such, Newness Butterworth, London (1972).

**APPLIED CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-432</b>
<b>Module title:</b>	<b>Applied Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

Students will learn that how to apply the basic and instrumental techniques to determine metal ions in metallurgical samples.

**SYLLABUS OUTLINE:**

Analysis Iron in steel by titrimetry, Analysis of Nickel in steel by Gravimetry and Solvent Extraction, Analysis of Chromium in steel by Spectrophotometry, Heavy metal analysis of steel by AAS, Analysis of dolomite, chromite and bauxite Ore by titration method.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Chemistry of iron and Steel Manufacture, C. Bodsworth, Longman Press, London, 1963.
3. Graham's Electroplating Engineering Hand Book, Ed. L.J. Durney, CBS Publishers and Distributors, New Delhi. (1997).
4. Nickel and Chromium plating, J.K. Dennis & T.E. Such, Newness Butterworth, London (1972).



**APPLIED CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-433</b>
<b>Module title:</b>	<b>Analytical Techniques</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will learn about the principle, theory and working of basic analytical techniques

**SYLLABUS OUTLINE:**

**1. Chromatography**

a. **Thin Layer Chromatography –**

Basic principle, theory and mechanism, stationary and mobile phase selection, locating reagents, applications, introduction to HPTLC

b. **High Performance Liquid Chromatography (HPLC) –**

Basic principle, types, theory and mechanism, stationary and mobile phase selection and types, basic parts of HPLC including pump, column, injector, detector, thermostat etc. Explanation of typical chromatogram highlighting retention time, peak height and width, tailing factor, resolution, theoretical plates, Isocratic and gradient elution and its significance, HPLC detectors such as Refractive Index, UV/Vis, photodiode array and fluorescence detector, Applications of HPLC

c. **Gas Chromatography Mass Spectrometry (GCMS) –**

Basic principle, theory and mechanism, stationary and mobile phase selection and types, basic parts of typical gas chromatography including sample injection port, gas reservoir, column and detectors. Nature of samples to be analyzed by GCMS, temperature selection, packed and capillary columns, Mass analyzers, quaderpole mass analyzers, Time of flight analyzer Applications of GCMS

**2. Spectroscopy**

Introduction, Basic Principle, Theory and Applications of Flame emission spectroscopy (FES), Flame atomic absorption spectroscopy (FAAS), continuous and line sources, construction of hollow cathode lamp, types of flames and their appropriate use, sensitivity and detection limits, Optical, Chemical, Physical and Ionization interferences and their possible solutions,

Introduction, Basic Principle, Theory and Applications of UV/Vis spectroscopy and Thermal Analysis Techniques.

**RECOMMENDED BOOKS:**

1. T. B. of Quantitative Inorganic Analysis, Vogel's Ed-4<sup>th</sup>, Longman Group Limited (1978).
2. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
3. Instrumental Analysis, Gary D. Christain, 1978, Introduction to Instrumental Analysis by Braun, McGraw-Hill Book company, 1987.
4. Instrumental Analysis by B.K. Sharma

**APPLIED CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-434</b>
<b>Module title:</b>	<b>Applied Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

Student will apply the analytical techniques for characterization of Industrial samples.

**SYLLABUS OUTLINE:**

Spectrophotometric analysis of iron in pharmaceutical tablets, Chlorides in water, phosphates in fertilizers, Chromium in Tannery wastewater, Recovery of chromium from tannery waste water, Application of AAS on analysis of heavy metals of various industrial effluents.

**RECOMMENDED BOOKS:**

1. T. B. of Quantitative Inorganic Analysis, Vogel's Ed-4<sup>th</sup>, Longman Group Limited (1978).
2. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
3. Instrumental Analysis, Gary D. Christain, 1978, Introduction to Instrumental Analysis by Braun, McGraw-Hill Book company, 1987.
4. Instrumental Analysis by B.K. Sharma

**APPLIED CHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-435</b>
<b>Module title:</b>	<b>Processing Industries</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will understand and learn about the operation and processes involved in Paper, Leather and Oils/Fats industries. Starting from raw material to end product.

**SYLLABUS OUTLINE:**

**1. Paper & Leather Industry**

Paper – History, Survey of Raw materials, Production of Pulp by Soda process, Sulphite process, Kraft (Sulphate) process, Recovery of cooking liquor, manufacturing of paper, Environmental aspects of paper Industry.

Leather – Introduction, Types of Skin, Theory of Tanning, Beamhouse Operations, Vegetable and Chrome tanning, Finishing processes, Waste Disposal and Pollution Aspects.

**2. Oils And Fats**

Classification of oils and fats, vegetable oils, essential oils, various methods of extraction of oils, refining and hydrogenation of oils, Industrial applications of oils in resins, surfactants, lubricants and paints.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Pulp and Paper Technology, Testing and Applications, K.P. Rao (2003), CBS Publishers.
3. Chemistry of Pulp and Paper making, Edwin Sutermeister, Ed-3<sup>rd</sup> (1946)
4. Fertilizers and Soil Fertility, U.S.Jones, Reston Publishing Co. Virginia, 1979.
5. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).
6. Shereve's Chemical Process Industries, 5th Ed.1975, by G.T.Austin, McGraw Hill Book Co. New York.

**BIOCHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-436</b>
<b>Module Title:</b>	<b>Nucleic Acids</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course will enable students to understand nucleic acid, its fundamental structure, properties and processes. It will also assist students to understand synthesis and degradation of purine and pyrimidine nucleotides.

**SYLLABUS OUTLINES**

Basics and importance of nucleic acids; major components and their structures, Phosphodiester linkage. Chargaff rules and Watson and Crick Postulates and their importance about the Structure of DNA. Classification of DNA and RNA and their importance. Chromatin and chromosomes. Determination of Primary structure of Nucleic acids. Nucleic acid hydrolysis. Biosynthesis and Catabolism of Purines and Pyrimidines. Biosynthesis of nucleotides. Urea cycle. Disorders linked to serum urate levels. Synthesis and splicing of RNA.

**RECOMMENDED BOOKS:**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000 Pub: worth Publishers
2. Biochemistry by Lubert Stryer(2006) Pub: Freeman and Company
3. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.
4. Lippincott's Biochemistry by champ c; Harvey.R.A and Ferrie. D .R. 3<sup>rd</sup> edition., Pub: J. B. Lippincott company

**BIOCHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-437</b>
<b>Module Title:</b>	<b>Bio Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The course will be helpful for students to understand the absorption, isolation and estimation of genetic material by using animal sources.

**SYLLABUS OUTLINES**

- Preparation of solution for the Isolation of RNA from animal sources.
- UV absorption of nucleic acids.
- Isolation of DNA by organic and inorganic method.
- Qualitative and Quantitative estimation of DNA by gel electrophoresis.
- Spectrophotometric analysis of DNA and RNA.
- DNA purification by gel electrophoresis
- Use of micro pipettes of varying range.
- Isolation and estimation of DNA from plant sources.

**RECOMMENDED BOOKS:**

1. Practical clinical Biochemistry by Varley. Pub: CBSpublishersAn
2. Introduction to Practical Biochemistry By D. T. Plummer Pub: McGrawHill
3. Practical Clinical Biochemistry 4th Edition (English, Paperback, Harold Varley)
4. Varleys Practical Clinical Biochemistry 6th Edition (English, Hardcover, Alan H. Gowenlock)

**BIOCHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-438</b>
<b>Module Title:</b>	<b>Human Physiology</b>
<b>Name of scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

After studying this course, students will be able to understand human physiology and body fluids. It will help to understand composition of blood and CSF. It will also help to explain the structure, functioning and importance of human immune system in term of health and disease. Identify the major components of the endocrine system and describe their functions. The mechanisms of hormone action and the role hormones play in body.

**SYLLABUS OUTLINES**

Introduction to human physiology. Body fluids; General composition of Blood and blood plasma. Biosynthesis and metabolism of Porphyrin and Hemoglobin. Coagulation and anti-coagulating agents of blood. Composition and Biochemical effects of urine. Composition and importance of CSF. Structure and detoxification function of liver and Kidney. Introduction to Endocrine system. Mechanisms of action, and Biological functions of Pancreatic, Pituitary, Gonadal, Adrenal, Thyroid and Parathyroid hormones. Pheromones.

**RECOMMENDED BOOKS:**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,200  
Pub: worth Publishers
2. Biochemistry by Lubert Stryer(2006) Pub: Freeman and Company
3. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.
4. Guyton and Hall Textbook of Medical Physiology (12th Edn)

**BIOCHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-439</b>
<b>Module Title:</b>	<b>Bio Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

This course will help students to understand practical grounds of urine and blood analysis. In addition, it will assist to estimate blood constituents.

**SYLLABUS OUTLINES**

- Analysis of organic constituents of blood.
- Mineral determination such as calcium and magnesium by titration and atomic absorption spectroscopy.
- Mineral determination of sodium and potassium by flame photometry.
- Mineral determination of zinc, phosphate and cobalt by atomic absorption spectroscopy.
- Analysis of Urea, creatinine, cholesterol, triglycerides and Biliuribin by chemical method.
- Determination of blood groups.

**RECOMMENDED BOOKS:**

1. Practical clinical Biochemistry by Varley. Pub: CBSpublishers
2. An Introduction to Practical Biochemistry By D. T. Plummer Pub: McGrawHill
3. Practical Clinical Biochemistry 4th Edition (English, Paperback, Harold Varley)
4. Varleys Practical Clinical Biochemistry 6th Edition (English, Hardcover, Alan H. Gowenlock)

**BIOCHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-440</b>
<b>Module Title:</b>	<b>Enzymology</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

After studying these course students will be able to understand types of enzymes. It will also help to understand the factors affecting enzyme activity and Chemical kinetics of enzymes.

**SYLLABUS OUTLINES**

Chemical nature, nomenclature and classification of enzymes. Cofactors and Coenzymes. Concepts of active site and substrate specificity. Factors affecting the enzyme activity. Kinetics of single substrate enzymatic reactions. Competitive, non-competitive and irreversible enzyme inhibition. Mechanism of enzyme inhibition. Regulatory, allosteric, immobilized enzymes, zymogens, isoenzyme and multienzyme system.

**RECOMMENDED BOOKS:**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000 Pub: worth Publishers
2. Biochemistry by Lubert Stryer (2006) Pub: Freeman and Company
3. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.
4. Lippincott's Biochemistry by champ c; Harvey.R.A and Ferrie. D .R. 3<sup>rd</sup> edition., Pub: J. B. Lippincott company



**BIOCHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-441</b>
<b>Module Title:</b>	<b>Bio Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

In this module student will learn how to isolate enzyme from different sources and effects of different parameters on enzymes activity. It will also provide practical grounds of enzyme inhibition by using UV/Visible spectrophotometer. Students will use assay methods to estimate clinically important enzymes.

**SYLLABUS OUTLINES**

- Isolation of enzyme from different sources.
- Study of different factors like temperature, pH, Concentration of substrate on the properties of Alkaline Phosphatase and LDH.
- Determination of the kinetic parameters of the enzymes and their mode of inhibition using UV / Visible Spectrophotometer.
- Estimation of Clinically important enzymes like alkaline phosphatase, acid phosphatase, SGPT, SGOT, creatine kinase, etc by using specific assay methods
- Agglutination tests; Enzyme linked immunosorbent assay (ELISA), Western blotting.

**RECOMMENDED BOOKS:**

1. Practical clinical Biochemistry by Varley. Pub: CBS publishers.
2. Introduction to Practical Biochemistry By D. T. Plummer Pub: McGrawHill.
3. Practical Clinical Biochemistry 4th Edition (English, Paperback, Harold Varley).

**BIOCHEMISTRY (BS-ADP 7<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>CHEM-442</b>
<b>Module Title:</b>	<b>Immunochemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 7<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

After studying this course, student will be able to understand antigens, antibodies and immunity. It will also help to understand the abnormalities of immune system.

**SYLLABUS OUTLINES**

The immune system. Detailed structure, chemistry and synthesis of immunoglobulins. Immunogenicity and antigenicity. Properties of Immunogens for B and T lymphocytes activation. Myeloma and hybridoma immunoglobulins. Complement system. Inflammatory process. Peripheral leucocytes and Macrophages. Abnormalities of the immune system- autoimmunity.

Diagnostically important plasma enzymes and proteins, identification and treatment of enzyme deficiencies. Assessment of cell damage, factors affecting results of plasma essay, abnormal plasma enzymes

**RECOMMENDED BOOKS:**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000  
Pub: worth Publishers
2. Biochemistry by Lubert Stryer (2006) Pub: Freeman and Company
3. A biologist's guide to Principles and Techniques of Practical Biochemistry by Bryan L Williams and Keith Wilson Pub: Edward Arnold Ltd.
4. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.
5. Lecture notes on clinical chemistry, Alistaire F Smith, Geoffrey Beckett, Simon walker, Peter Rae 6th Edition, John Wile & Sons, 1998

**PHYSICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-443</b>
<b>Module title:</b>	<b>Polymer Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will learn chemistry of all types of polymers in this course. They will be able to understand synthetic techniques of various polymers. They will be able to characterize polymer samples using different analytical techniques.

**SYLLABUS OUTLINES**

An introduction to polymers, Classification of polymers, kinetics of condensation and addition (free radical, cationic and anionic polymerization), copolymers and their classification, kinetics of copolymerization, concept of molecular mass average in polymers and its determination Molecular mass distribution, determination of molecular mass average (viscosity average, number average and weight average) by different methods. Analysis techniques like spectroscopic methods (UV visible and IR) and thermal analysis.

**RECOMMENDED BOOKS**

1. Billmeyer, F, Textbook of Polymer Science, 2nd ed., John Wiley and Sons, Inc., NY (1971).
2. Physical Chemistry by Kundu, N and Jain, S.K.S. Chand and Company Ltd. 1984.
3. Physical chemistry by Atkins, P.W. 5th Ed., W.H.Freeman and Company, New York, 1994.
4. Physical Chemistry by Alberty, R.A. and Silbey. R.J., John Wiley, New York, 1995.
5. Physical chemistry by Engel, T. and Ried, P., 1st Ed., Pearson Education, Inc. 2006.
6. Hand book of surface and Colloid Chemistry by Birdi, K.S., CRC Press, 1997.
7. Te Nijenhuis, Klaas. Thermoreversible networks: viscoelastic properties and structure of gels. Vol. 130. Berlin Heidelberg: Springer, 1997.
8. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House, (2014).

**PHYSICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-444</b>
<b>Module title:</b>	<b>Physical Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP8<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

This course will enable the students to analyze polymer samples and to investigate their properties.

**SYLLABUS OUTLINES**

1. Molecular Mass Determination of different Polymers by Viscosity measurement.
2. Determination of heat of solution of a substance by solubility methods.
3. Determination of CMC of block copolymer/polymeric surfactant by surface tension method.
4. Preparation of different polymeric systems and their characterization by FTIR.
5. Determination of partial molar properties.

**RECOMMENDED BOOKS**

1. Advanced Experimental Physical Chemistry by Ayodhya Sing.
2. Experimental Physical Chemistry by Daniel
3. Experimental Physical Chemistry by G.Peter Matthews.
4. Experiments in Physical Chemistry by Shoemaker

**PHYSICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-445</b>
<b>Module title:</b>	<b>UV &amp; Raman Spectroscopy</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will learn basic of all types of electronic and Raman spectroscopy and will be able to apply this knowledge in practical applications.

**SYLLABUS OUTLINES**

Principles of electronic transition. Types of electronic transition. Energies of atomic orbital-with reference of H-atom spectrum electronic angular momentum fine structure of H-atom spectrum. Photoelectron spectroscopy (PES).

Raman Spectra-idea of Raman scattering, Theories of Raman effect Rayleigh scattering Molecular polarizability. Rotational Raman Spectra of linear Molecules. Symmetric top molecules and spherical top molecules Vibrational Raman spectra.

**RECOMMENDED BOOKS**

1. Molecular spectroscopy by KV Raman, R Gopalan, P S Raghavan, Vijay Nicole imprints Ltd. 2004.
2. Physical Chemistry by Kundu, N and Jain, S.K.S. Chand and Company Ltd. 1984.
3. Fundamentals of chemical kinetics by Logan, S.R, Longman Group Ltd. 1996.
4. Elementary reaction kinetics by Latham.J.L. And Burgess, A.E.3rd Ed., Butterworths, London, 1977.
5. Physical chemistry by Atkins, P.W. 5th Ed., W.H.Freeman and Company, New York, 1994.
6. Physical Chemistry by Alberty, R.A. and Silbey. R.J., John Wiley, New York, 1995.
7. Physical chemistry by Engel, T. and Ried, P., 1st Ed., Pearson Education, Inc. 2006.

**PHYSICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-446</b>
<b>Module title:</b>	<b>Physical Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP8<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

Students will be trained for practical applications of spectroscopic methods. They will be able to monitor the progress of a chemical reaction using spectroscopic methods.

**SYLLABUS OUTLINES**

1. Evaluation of pK<sub>a</sub> value of an indicator by spectrometric method.
2. Kinetics of the reaction between methyl orange and peroxodisulphate ions in presence of bromide ions.
3. Spectroscopic determination of Cu percentage in the given sample.
4. Characterization of the given compound by UV-Vis spectroscopy.
5. Determination of molar extinction co-efficient of a colored substance.

**RECOMMENDED BOOKS**

1. Advanced Experimental Physical Chemistry by Ayodhya Sing.
2. Experimental Physical Chemistry by Daniel
3. Experimental Physical Chemistry by G.Peter Matthews.
4. Experiments in Physical Chemistry by Shoemaker

**PHYSICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-447</b>
<b>Module title:</b>	<b>Photochemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will be able to learn fundamentals and applications of photochemistry in this course.

**SYLLABUS OUTLINES**

Laws of photochemistry, quantum efficiency and its determination, Photochemical reactions, excited state symbols; photosensitized reactions, phosphorescence, fluorescence, chemiluminescence, Lasers.

**RECOMMENDED BOOKS**

1. Mukherjee, K.K.R., Fundamentals of Photochemistry, Revised Ed., New Age International (P) limited, Publishers, New Delhi, (2000).
2. Molecular spectroscopy by KV Raman, R Gopalan, P S Raghavan, Vijay Nicole imprints Ltd. 2004.
3. Physical Chemistry by Kundu, N and Jain, S.K.S. Chand and Company Ltd. 1984.
4. Physical chemistry by Atkins, P.W. 5th Ed., W.H.Freeman and Company, New York, 1994.
5. Physical Chemistry by Alberty, R.A. and Silbey. R.J., John Wiley, New York, 1995.
6. Physical chemistry by Engel, T. and Ried, P., 1st Ed., Pearson Education, Inc. 2006.
7. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House, (2014).

**PHYSICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-448</b>
<b>Module title:</b>	<b>Physical Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP8<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

Students will learn different experimental skills related to physical chemistry and photochemistry.

**SYLLABUS OUTLINES**

1. Investigation of the kinetics of hydrolysis of ethyl acetate in the presence of an acid.
2. Determination of the relative strength of acids (HCl and H<sub>2</sub>SO<sub>4</sub>) studying the hydrolysis of an ester.
3. Verification of Langmuir adsorption isotherm for Adsorption of acetic acid on active charcoal.
4. Determination of surface excess concentration of an emulsifier by surface tension method.
5. Characterization of the given compound by FTIR spectroscopy.

**RECOMMENDED BOOKS**

1. Advanced Experimental Physical Chemistry by Ayodhya Sing.
2. Experimental Physical Chemistry by Daniel
3. Experimental Physical Chemistry by G.Peter Matthews.
4. Experiments in Physical Chemistry by Shoemaker



**PHYSICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-449</b>
<b>Module title:</b>	<b>Nuclear Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

The course is designed to strengthen fundamental knowledge of students for understanding of processes based on nuclear chemistry.

**SYLLABUS OUTLINES**

Composition of the nucleus, natural and artificial radioactivity, rate of radioactive disintegration, radioactive equilibrium, transformation of elements cyclotron and linear accelerators; nuclear processes; nuclear fission, atomic bomb, nuclear reactor, nuclear fusion, hydrogen bomb, steller energy, radiation hazards, use of tracers in chemistry.

**RECOMMENDED BOOKS**

1. Physical Chemistry by Kundu, N and Jain, S.K.S. Chand and Company Ltd. 1984.
2. Physical chemistry by Atkins, P.W. 5th Ed., W.H.Freeman and Company, New York, 1994.
3. Physical Chemistry by Alberty, R.A. and Silbey. R.J., John Wiley, New York, 1995.
4. Physical chemistry by Engel, T. and Ried, P., 1st Ed., Pearson Education, Inc. 2006.
5. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House, (2014).

**INORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-450</b>
<b>Module title:</b>	<b>Radioactivity</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

The aim of this course is to provide the concepts for better understanding of nuclear chemistry, radioactivity and its application in daily life and industry.

**SYLLABUS OUTLINE:**

**1. Radioactivity:**

Natural radioactivity, Artificial radioactivity, types of radioactive rays, Saddy-Fajans and Russel group displacement law, Half life period of a radioactive substance, Disintegration constant K, Average life period, Radioactive equilibrium, Law of successive disintegration, Activity of a radioactive substance, Transmutation of elements, Artificial transmutation reactions induced by different bombarding projectiles, Applications of artificial transmutation reactions, Natural and artificial radioactive series.

**RECOMMENDED BOOKS:**

1. Katz, Joseph J., Glenn T. Seaborg, and Lester R. Morss. The chemistry of the actinide elements. Volume 1. New York, USA: Chapman and Hall, 1986.
2. R.D.Madan, Satya Prakash's Modern Inorganic Chemistry, S. Chand Company and Ltd, 2002.
3. OpenStax . (2016) Chapter 21 – Nuclear Chemistry. Chemistry by Rice University is licensed under a Creative Commons Attribution 4.0 International Accessed, Dec 1st, 2018 from: <https://opentextbc.ca/chemistry/chapter/introduction-2/>
4. J.D.Lee, Concise Inorganic Chemistry, 5<sup>th</sup> Edition.

**INORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-451</b>
<b>Module title:</b>	<b>Inorganic Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The aim of this course is to interpret the concepts for better understanding in inorganic chemistry. This course will familiarize the students use of instrumental methods of analysis, (AAS, FES).

**SYLLABUS OUTLINE:**

**Instrumental methods of analysis:**

- i. Atomic absorption spectroscopy**  
Estimation of following:  
 $Mg^{2+}$ ,  $Zn^{2+}$ ,  $Al^{3+}$ ,  $Cu^{2+}$ ,  $Fe^{2+}$ ,  $Ni^{2+}$ ,  $Pb^{2+}$ ,  $Cd^{2+}$
- ii. Flame Photometer spectroscopy**  
Estimation of following:  
 $Li^+$ ,  $Na^+$ ,  $K^+$ ,  $Ca^{2+}$

**RECOMMENDED BOOKS:**

1. Vogel, Arthur I. A Text-Book Of Quantitative Inorganic Analysis-Theory And Practice. Longmans, Green And Co.; London; New York; Toronto, 2013.
2. Quantitative Analysis Chemistry, James S. Pritz, George H. Schenk, 1987 Alby and Becon Inc. London.
3. Theory and practice of chromatography by Prof. Dr. Javed Iqbal (2002).
4. Rabia Rehman and Haq Nawaz Bhatti, "Experimental Inorganic Chemistry", Carvan Book House Lahore in 2015.
5. Haq Nawaz Bhatti and Rabia Rehman "Advanced Experimental Inorganic Chemistry" Carvan Book House Lahore in 2017.
6. Mendham, John. Vogels textbook of quantitative chemical analysis. Pearson Education India, 2006.

**INORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-452</b>
<b>Module title:</b>	<b>Bio-inorganic Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

The aim of this course is to provide the concepts for better understanding of biological systems and chemistry working behind various physiological processes. The students will learn about inorganic chemistry in biological systems and various medicinal compounds used for curing disease by heavy metals toxicity.

**SYLLABUS OUTLINE:**

**1. Biological aspects of inorganic compounds:**

Energy sources for life, metalloporphyrins. Photosynthesis, Chlorophyll, Respiration, Heme and Non heme proteins, cytochromes, Nitrogen fixation: in vitro and in vivo, the biochemistry of Iron, calcium, magnesium, Sodium, Potassium. Essential and trace elements in biological systems, biochemistry of the nonmetals: Carbon, Phosphorus, Oxygen, Silicon. Toxicity of heavy metals in biological systems, medicinal chemistry, chelate therapy for curing disease by heavy metals toxicity.

**RECOMMENDED BOOKS:**

1. Inorganic Chemistry by James E. Huheey 1983 Harper International London.
2. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkineon 1972, Interscience, Publishers, London.
3. R.D.Madan, Satya Prakash's Modern Inorganic Chemistry, S. Chand Company and Ltd, 2002.
4. J.D.Lee, Concise Inorganic Chemistry, 5<sup>th</sup> Edition.

**INORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-453</b>
<b>Module title:</b>	<b>Inorganic Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The aim of this course is to interpret the concepts for better understanding in inorganic chemistry. This course will familiarize the students use of chromatographic techniques and inorganic compounds preparations.

**SYLLABUS OUTLINE:**

**1. Chromatographic Techniques:**

Thin layer techniques for the qualitative analysis of group II & IV metal complexes.

**2. Preparations:**

- (i) Sodium Cobaltinitrite.
- (ii) Pot. Trioxalato Aluminate.
- (iii) Pot. Trioxalato ferrate.
- (iv) Ammonium sulphate Nickel (II) Sulphate.
- (v) Ammonium Sulphate Copper (II) Sulphate Pentahydrate.

**RECOMMENDED BOOKS:**

1. Pass, Geoffrey. Practical inorganic chemistry: preparations, reactions and instrumental methods. Springer Science & Business Media, 2013.
2. Vogel, I. (1724). A Text-Book of Macro And Semimicro Qualitative Inorganic Analysis. Willam Clowes And Sons Limited; London; Bxccles.
3. Vogel, Arthur I. A Text-Book Of Quantitative Inorganic Analysis-Theory And Practice. Longmans, Green And Co.; London; New York; Toronto, 2013.
4. Quantitative Analysis Chemistry, James S. Pritz, George H. Schenk, 1987 Alby and Becon Inc. London.
5. Theory and practice of chromatography by Prof. Dr. Javed Iqbal (2002).
6. Rabia Rehman and Haq Nawaz Bhatti, "Experimental Inorganic Chemistry", Carvan Book House Lahore in 2015.
7. Haq Nawaz Bhatti and Rabia Rehman "Advanced Experimental Inorganic Chemistry" Carvan Book House Lahore in 2017.
8. Mendham, John. Vogels textbook of quantitative chemical analysis. Pearson Education India, 2006.

**INORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-454</b>
<b>Module title:</b>	<b>Organometallics</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

The aim of this course is to provide the concepts for better understanding of advance study in inorganic chemistry and other interdisciplinary subject related to inorganic chemistry. The students will learn about inorganic chemistry in biological systems, organometallic compounds (synthesis aspects, structural and bonding aspects).

**SYLLABUS OUTLINE:**

**Organo Metallic Chemistry:**

**(a) Introduction to organometallic chemistry**

Nature of carbon-metal bond, General synthesis and properties of organometallic compounds, Classification (<sup>σ</sup>n<sub>2</sub>-bonded olefin, n<sub>3</sub>-allylic, n<sub>4</sub>-cyclopentadienyl, n<sub>6</sub>-organometallic compounds).

**(b) Structure and reactivities**

Experimental techniques in Organometallic chemistry, oxidative-addition, reductive elimination, insertion and de-insertion reactions, fluxional behaviour. Applications of organometallic compounds. Characterization of organometallic compounds with the help of IR, NMR, mass spectrometry etc.

**RECOMMENDED BOOKS:**

1. Organotransition metal Chemistry by Akin Yamamoto, 1986, A. Wiley Interscience Publication London.
2. Inorganic Chemistry by James E. Huheey 1983 Harper International London.
3. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkinson 1972, Interscience, Publishers, London.
4. Comprehensive organometallic chemistry, M. Imran, H. M. Farooq, IIMI Kitab Khana, Lahore, 2019.
5. J.D.Lee, Concise Inorganic Chemistry, 5<sup>th</sup> Edition.

**INORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-455</b>
<b>Module title:</b>	<b>Inorganic Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

The aim of this course is to interpret the concepts for better understanding in inorganic chemistry. This course will familiarize the students use of instrumental methods of analysis and salt analysis.

**SYLLABUS OUTLINE:**

1. **Application of Atomic Spectroscopy**  
Theory and application of Flame photometer. Atomic absorption spectrophotometer, Inductively coupled plasma emission. Metal contents analysis of clinical, industrial, geochemical, biological and environmental samples.
2. **Salt Analysis**  
Identification of acid and basic radicals of a given salt/mixture.

**RECOMMENDED BOOKS:**

1. Vogel, I. (1724). A Text-Book Of Macro And Semimicro Qualitative Inorganic Analysis. Willam Clowes And Sons Limited; London; Bxccles.
2. Vogel, Arthur I. A Text-Book Of Quantitative Inorganic Analysis-Theory And Practice. Longmans, Green And Co.; London; New York; Toronto, 2013.
3. Quantitative Analysis Chemistry, James S. Pritz, George H. Schenk, 1987 Alby and Becon Inc. London.
4. Theory and practice of chromatography by Prof. Dr. Javed Iqbal (2002).
5. Rabia Rehman and Haq Nawaz Bhatti, "Experimental Inorganic Chemistry", Carvan Book House Lahore in 2015.
6. Haq Nawaz Bhatti and Rabia Rehman "Advanced Experimental Inorganic Chemistry" Carvan Book House Lahore in 2017.

**INORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-456</b>
<b>Module title:</b>	<b>Inorganic Polymers</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

The aim of this course is to provide the concepts for better understanding of advance study in inorganic chemistry and other interdisciplinary subject related to inorganic chemistry. The students will learn about advanced atomic spectroscopy and radio chemistry, polymeric inorganic compounds, advanced chemistry of s-block elements.

**SYLLABUS OUTLINE:**

- (a) Chains: Catenation, Homocatenation, Heterocatenation, Silicones, Silicates, Zeolites, talc, mica, clay.
- (b) Rings: (i) Heterocyclic systems of borazines, Phosphazenes, S-N rings.  
(ii) Homocyclic system of sulfur and selenium.
- (c) Cages compounds of phosphorus, and boron
- (d) Inorganic Polymers as Conductors.

**RECOMMENDED BOOKS:**

1. Mark, James E., et al. Inorganic polymers. Oxford University Press on Demand, 2005.
2. Archer, Ronald D. Inorganic and organometallic polymers. Vol. 4. John Wiley & Sons, 2004.
3. Uchimaru, Yuko. "Borazine Polymers." Encyclopedia of Polymeric Nanomaterials. Springer, Berlin, Heidelberg, 2015. 255-262.



**ORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-457</b>
<b>Module title:</b>	<b>Natural Products</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 Credits</b>

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**OBJECTIVES:**

To develop knowledge about the basic rules and principles for working, instrumentation, sample handling and applications for structural characterization of organic compounds by Mass spectrometry. To gain understanding about the isolation and general methods of structure determination and biosynthesis of different classes of natural products.

**SYLLABUS OUTLINES:**

**1. Mass Spectrometry**

Introduction; types, Isotopic abundance, molecular and metastable ions; modes of fragmentation, applications of mass spectrometry in different classes of organic chemistry, interpretation of mass spectra of small organic molecules.

**2. Natural Products**

Introduction, classification, isolation and general methods of structure determination of alkaloids, terpenes, (triterpenoids and steroids), biosynthesis of alkaloids, steroids & terpenoids and their stereochemistry.

**RECOMMENDED BOOKS:**

1. Organic Spectroscopy and Chromatography, by M. Younas. Ilmi kitab khana, kabir street, urdu bazar, Lahore.
2. Organic Chemistry, (4<sup>th</sup> - 7<sup>th</sup> Ed) by Paula Yurkanis Bruice, Pearson Education (Singapore) Pvt. Ltd. 2004-2015.
3. Introduction to Spectroscopy by Donald L. Pavia, Gary M. Lampman, George S. Kriz, (2<sup>nd</sup> – 5<sup>th</sup> Ed). Saunders Golden Sunburst Series, 1996-2018.
4. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
6. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.
7. Chemistry for Pharmacy Students by Satyajit D Sarkar, Lutfun Nahan. John Wiley & Sons, Ltd 2007.
8. Natural Product Chemistry at a Glance by Stephen P. Stanforth. Blackwel Publishing ltd, 9600 Garsuington Road, Oxford OX4 2DQ, UK.

**ORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-458</b>
<b>Module title:</b>	<b>Organic Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 Credit</b>

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**OBJECTIVES:**

To gain experimental skills for separation, purification by chromatography (TLC, etc) and analysis of different organic compounds by spectroscopy (UV, IR).

**SYLLABUS OUTLINES:**

**Purification and Spectroscopic Identification**

Preparation of hydrazones of aromatic aldehydes and ketones and their spectroscopic analysis. Preparation, separation and identification of regio-isomers: *o*-nitrotoluene and *p*-nitrotoluene from toluene; *o*-nitrosophenol and *p*-nitrosophenol from phenol etc.

**RECOMMENDED BOOKS:**

1. The Systematic Identification of Organic Compounds (8<sup>th</sup> Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5<sup>th</sup> Ed.) by A.I. Vogel et al. Longman, UK, 1989.
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. Advanced Practical Organic Chemistry (2<sup>nd</sup> Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.

**ORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-459</b>
<b>Module title:</b>	<b>Organic Synthesis</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 Credits</b>

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**OBJECTIVES:**

To acquire knowledge about the usefulness of synthetic organic chemistry involving the application of new reagents. To develop basic understanding about asymmetric synthesis, application of protecting groups in organic synthesis and disconnection approach (Retrosynthesis).

**SYLLABUS OUTLINES:**

**1. Organic Synthesis**

An outline of the recent developments in organic syntheses involving new reagents, reaction conditions and methods; Asymmetric synthesis. Introduction to protective groups, protection of hydroxyl, amino, carbonyl and carboxylic acid groups, and their deprotection, synthetic applications of these protective groups in total synthesis of organic molecules. Introduction to disconnection approach with examples.

**RECOMMENDED BOOKS:**

1. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
2. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
3. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
4. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and R.K. Boyd, Benjamin Cummings, 1992.
6. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.
7. Organic Synthesis, The disconnection approach, Stuart Warren, John Willey and Sons 1993; and work book be same 1994.
8. Designing Organic Synthesis, A Programmed Introduction to synthon approach, S. Warren, John Willey and Son, 1992.
9. Guide book to Organic Syntheses, R. K. Mackie, D. M. Smith, Longman Group Limited, 1982.

**ORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-460</b>
<b>Module title:</b>	<b>Organic Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 Credit</b>

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**OBJECTIVES:**

To gain experimental skills for different organic reactions, separation and identification of products obtained in a multistep organic synthesis.

**SYLLABUS OUTLINES:**

**1. Organic Synthesis**

Multi-step preparation and spectroscopic characterization: Benzoin to benzyl to benzylic acid; *p*-nitroaniline from aniline; *p*-bromotoluene from *p*-toluidine, *o*-Bromotoluene from *o*-toluidine, Appel reaction and Finklestein reaction etc.

**RECOMMENDED BOOKS:**

1. The Systematic Identification of Organic Compounds (8<sup>th</sup> Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5<sup>th</sup> Ed.) by A.I. Vogel et al. Longman, UK, 1989.
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. Advanced Practical Organic Chemistry (2<sup>nd</sup> Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.

**ORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-461</b>
<b>Module title:</b>	<b>Heterocyclic Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 Credits</b>

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**OBJECTIVES:**

To develop basic understanding about methods of preparation, reactions and applications of different types of heterocyclic compounds.

**SYLLABUS OUTLINES:**

**1. Heterocyclic Chemistry**

Five and six membered aromatic and aliphatic heterocyclic compounds with one and more identical hetero-atoms, five and six membered heterocycles with two different hetero-atoms. Their syntheses and reactions

**RECOMMENDED BOOKS:**

1. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
2. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
3. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
4. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and R.K. Boyd, Benjamin Cummings, 1992.
6. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.
7. Organic Synthesis, The disconnection approach, Stuart Warren, John Willey and Sons 1993; and work book be same 1994.
8. Designing Organic Synthesis, A Programmed Introduction to synthon approach, S. Warren, John Willey and Son, 1992.
9. Guide book to Organic Syntheses, R. K. Mackie, D. M. Smith, Longman Group Limited, 1982.

**ORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-462</b>
<b>Module title:</b>	<b>Organic Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 Credit</b>

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**OBJECTIVES:**

To gain experimental skills for separation and identification of three components in a mixture of unknown compounds via systematic physical and chemical tests.

**SYLLABUS OUTLINES:**

**1. Qualitative analysis**

Three component organic mixture analysis (separation and identification of the unknown components). Recrystallization and Derivatizations

**RECOMMENDED BOOKS:**

1. The Systematic Identification of Organic Compounds (8<sup>th</sup> Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5<sup>th</sup> Ed.) by A.I. Vogel et al. Longman, UK, 1989.
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. Advanced Practical Organic Chemistry (2<sup>nd</sup> Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.

**ORGANIC CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-463</b>
<b>Module title:</b>	<b>Reaction Mechanism-IV</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 Credits</b>

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**OBJECTIVES:**

To grasp ideas about the mechanisms, basic rules and principles working behind different types of pericyclic reactions. Introduction, method of generation, reactions and applications of reactive intermediates.

**SYLLABUS OUTLINES:**

**1. Reactive Intermediates**

Carbenes, nitrenes, and benzyne, structure and evidence for formation, general reactions and synthetic applications.

**2. Pericyclic reactions**

Introduction, Woodward-Hoffmann rules and molecular orbital theory; cycloaddition, electrocyclic and sigmatropic rearrangement and group transfer reactions.

**RECOMMENDED BOOKS:**

1. Organic Chemistry, Vol. I (6<sup>th</sup> Ed.) and II (5<sup>th</sup> Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
2. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6<sup>th</sup> Ed.) by M.B. Smith and J. March, Wiley, 2007.
3. A Text-Book of Organic Chemistry by M. Younas, ILMI, Pakistan.
4. Organic Chemistry, (5<sup>th</sup> Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
5. Organic Chemistry, (6<sup>th</sup> Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
6. Organic Chemistry, (6<sup>th</sup> Ed.) by R.T. Morrison, R.N. Boyd and R.K. Boyd, Benjamin Cummings, 1992.
7. Electrocyclic Reactions, by F.L. Ansari, R. Qureshi, M.L. Qureshi, Wiley-VCH, 1999.
8. Reactive Intermediates in Organic Chemistry, by N.S. Isaac, John Wiley and Sons, 1974.
9. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

**ANALYTICAL CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-464</b>
<b>Module title:</b>	<b>Electroanalysis Method-II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

This course deals with the electroanalytical techniques. The students will learn the details about the theory and applications of advanced electroanalytical techniques including coulometry, voltammetry, polarography, amperometry and conductometry. After this course, the students will be able to understand the mechanisms involved in these techniques and their applications for multielemental analysis

**SYLLABUS OUTLINE:**

1. **Voltrametry:**  
Excitation signals in voltametry, voltametric Instrumentation, Hydrodynamic Voltrametry, Cydic Voltametry, Stripping methods, voltametric with ultra-micro-electrodes
2. **Polarography:**  
Introduction and principle of polarography, basic instrumentation, working and advantages of DME (dropping mercury electrode); limiting and residual current; half-wave potential; qualitative and quantitative aspects of polarographical analysis
3. **Amperometry:**  
Principle of Amperometry, types of amperometry and amperometric titrations, amperometric titrations with one micro-electrode, amperometric titration with twin microelectrodes, applications of amperometry.

**RECOMMENDED BOOKS:**

1. Vogels, s text book of quantitative inorganic analysis by J. Bassett. The English language book Society and Longman.
2. Vogels, text book of Quantitative chemical analysis by J. mendham, RCDenny, JDBarnes, MJ KTHomas, Pearson education Ltd.
3. Fundamentals of Analytical Chemistry by Skoog, West and Holler (5<sup>th</sup> Edition).
4. Principles of Instrumental Analysis, Skoog, Holler and Neman (5<sup>th</sup> Edition).



**ANALYTICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-465</b>
<b>Module title:</b>	<b>Analytical Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

The students will learn the in-hand use of electroanalytical techniques like Voltametry in quantitative analysis of various acids and bases. The students will learn to obtain relevant information from these analyses and interpret the results obtained.

**SYLLABUS OUTLINE:**

- Reduction of ferricyanide ion using Pt electrode
- Oxidation of acetaminophen using glassy carbon electrode
- Preparation of carbon paste electrode
- Determination of Electrode surface area using cyclic voltammetry using potassium ferricyanide solution
- Effect of scan rate on the electrode properties using potassium ferricyanide solution
- Determination of half-wave potential for various analytes
- Determination of metal ions using anodic stripping voltammetry by carbon paste electrode
- Determination of various organic molecules using voltammetric studies

**RECOMMENDED BOOKS:**

1. New Instrumental Methods in Electro Chemistry by Faul-Delabay, Inter Science Publisher, London, N.Y.

**ANALYTICAL CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-466</b>
<b>Module title:</b>	<b>Compound Analysis</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

This course is about the advanced spectroscopic techniques. The students will learn the advanced structural elucidation techniques. They will be able to determine the structure of various molecules on the basis of their NMR and mass spectrometric data. The use of laser spectroscopy for the purpose of analysis will also be studied in this course

**SYLLABUS OUTLINE:**

1. **Nuclear Magnetic Resonance Spectroscopy:**  
Basic principles; properties of nuclei, Chemical shifts; Spin-Spin coupling; Pulsed Fourier Transform NMR Spectrometry; Identification of structural features; Use of NMR imaging in medicine; Analytical applications of NMR spectroscopy.
2. **Mass Spectrometry:**  
Principle, sample for mass spectrometer, sample introduction system, ionization source, mass analyzers, detection system, qualitative analysis, quantitative analysis, applications, confirmation of synthesis products, isotopes incorporation, structure elucidation, hyphenated mass-spectrometric techniques.

**RECOMMENDED BOOKS:**

1. New Instrumental Methods in Electro Chemistry by Faul-Delabay, Inter Science Publisher, London, N.Y.
2. Instrumental Methods of Analysis by Hobert H. Willart, Lyle L. Merrit, D. Van Nosrant Company Inc. N.Y. London.
3. Principles of Polarography by J. Herosky & J. Kuta, Academic Press N.Y. (1968).
4. Analytical chemistry by Kellner, J.M. Mermet, Wiley-VCH Verlag GmbH & Co. KGaA.
5. A text book of analytical chemistry by Y-Anjaneyulu, K-chamdarekhar, Vali Manickam, Pharma book syndicate.

**ANALYTICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-467</b>
<b>Module title:</b>	<b>Analytical Chemistry Lab – II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

This course is about the advanced spectroscopic techniques. The students will learn the advanced structural elucidation techniques. They will be able to determine the structure of various molecules on the basis of their NMR and mass spectrometric data.

**SYLLABUS OUTLINE:**

- Determination of Chemical Shift values for protons in Ethanol
- Elucidation of <sup>1</sup>H NMR spectrum of Acetone, Ethanol, Benzoic acid, acetaminophen
- Determination of coupling constant in <sup>1</sup>H NMR spectra
- Determination of isomers based on their <sup>1</sup>H NMR spectra
- Structure Elucidation of poly aromatic hydrocarbons (PAH) by GC-MS.
- Identification of haloacetic acid (HAA) by using GC-MS

**RECOMMENDED BOOKS:**

1. Analytical chemistry by Kellner, J.M. Mermet, Wiley-VCH Verlag GmbH & Co. KGaA.
2. A text book of analytical chemistry by Y-Anjaneyulu, K-chamdare khar, ValiManickam, Pharma book syndicate.

**ANALYTICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-468</b>
<b>Module title:</b>	<b>Thermoanalysis Method</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

In This course, the students will be able to learn the use of laser spectroscopy for the purpose of analysis. Furthermore, the structural features responsible for the luminescence and The role of thermal methods in the analysis of various samples will also be studied.

**SYLLABUS OUTLINE:**

**1. Thermal Methods of Analysis**

General Principle, instrumentation, Application, Limitations; of these techniques

- TGA (thermogravimetric analysis),
- DTA (differential thermal analysis),
- DSC (differential scanning calorimetry),
- TT (thermometric titrations) and
- EGD (evolved gas detection)

**RECOMMENDED BOOKS:**

1. 1.Vogels's text book of Quantitative chemical analysis by J.mendham, RCDenny, JDBarnes, MJ KTHomas, Pearson education Ltd.

**ANALYTICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-469</b>
<b>Module title:</b>	<b>Analytical Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES:**

The students will be able to analyse various samples by Thermal analysis methods.

**SYLLABUS OUTLINE:**

- Thermogravimetric analysis of calcium oxalate
- TG and DTG analysis of polymer gels
- TG and DTG analysis of polythene
- Determination of thermal stability of a given compound
- Determination of carbon black content in epoxy sample
- DTA analysis of biomass/plant materials
- Determination of purity/melting point of benzoic acid/oxalic acid/naphthalene

**RECOMMENDED BOOKS:**

1. Vogels, text book of Quantitative chemical analysis by J.mendham, RCDenny, JDBarnes, MJ KTHomas, Pearson education Ltd.

**ANALYTICAL CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-470</b>
<b>Module title:</b>	<b>Conducto/Oscillometry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8th Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES:**

This course is about the advanced spectroscopic techniques. The students will learn the advanced structural elucidation techniques. They will be able to determine the structure of various molecules on the basis of their NMR and mass spectrometric data. The use of laser spectroscopy for the purpose of analysis will also be studied in this course.

**SYLLABUS OUTLINE:**

**1. Laser Spectroscopy:**

Principle of laser operation; Stimulated emission Population inversion, Single level and multi-level laser systems, Properties of laser light and its general and analytical applications; ruby laser, nitrogen laser, dye laser, Use of laser radiation in absorption and fluorescence spectroscopic methods.

**2. Molecular Luminescence Fluorimetry and Phosphorimetry:**

Theory of Fluorescence and phosphorescence, instruments for measuring Fluorescence and phosphorescence and photoluminescence methods, chemiluminescence

**RECOMMENDED BOOKS:**

1. Laser spectroscopy by Wolfgang Demtroder, springerlink.
2. Fundamentals of Molecular Spectroscopy by Banwell.

**APPLIED CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-471</b>
<b>Module title:</b>	<b>Polymers</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course content will increase the understanding of student about Polymerization techniques; Basic theory, mechanisms, chemistry, processing and applications.

**SYLLABUS OUTLINE:**

**1. Polymerization Mechanisms**

Introduction, characteristics and significance, Classification including, synthetic and natural, thermoplastic and thermosets, Concept of homo and co-polymers, polyblends, Tacticity and its importance, Glass transition temperature, Molecular weight of Polymers, Polymerization types involving various mechanisms including addition and condensation polymerization, Ionic polymerization including anionic and cationic, Co-ordination polymerization.

**2. Polymers Processing**

Polymerization techniques – Bulk, Solution, Emulsion and Suspension techniques  
Polymer Fabrication – extrusion, injection, modeling and blow molding of plastics.  
Detailed description and uses of the following polymers:  
Polyethylene, Polystyrene, Epoxy resins, Polyethylene tetraphthalate, Elastomers, Conducting polymers and Biopolymers.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).
3. An Introduction to Polymer Chemistry, W.R.Moor, London Press, London.
4. Principles of Polymer Systems, Rodri-Guez, McGraw Hill Book Co. New York.
5. Modern Technology of Plastics and Polymer Processing Industries, NIIR Board

**APPLIED CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-472</b>
<b>Module title:</b>	<b>Applied Chemistry Lab - I</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1credit</b>

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**OBJECTIVES**

Students will apply their knowledge to synthesize and depolymerize the important polymers. Also will learn about the characterization of Oils and Fats

**SYLLABUS OUTLINE:**

Depolymerization of PET and Polyethene

Determination of Acid Value, Saponification Value, Ester value and iodine value of oils.

Preparation of Urea Formaldehyde, Phenol formaldehyde resins.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).
3. An Introduction to Polymer Chemistry, W.R.Moor, London Press, London.
4. Principles of Polymer Systems, Rodri-Guez, McGraw Hill Book Co. New York.
5. Modern Technology of Plastics and Polymer Processing Industries, NIIR Board



**APPLIED CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-473</b>
<b>Module title:</b>	<b>Agro-industries</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

This course content will increase the knowledge of the students regards the processes involved in Agro-based industries especially Fertilizers and Sugar.

**SYLLABUS OUTLINE:**

**1. Sugar and Fermentation Industries:**

Sugar - Importance of sugar industry, chemistry and sources of sucrose, manufacture of raw and refined sugar with flow sheet, estimation of sugar (physical and chemical methods)

Fermentation - importance of various fermentation industries, basic requirements for fermentation, steps in fermentation process. Manufacture of alcohol from molasses, preparation of absolute alcohol, proof spirit, and denatured spirit.

**2. Fertilizers**

Need of Fertilizers; Classification of Fertilizers, Importance of Macro- and Micro-nutrients; Raw materials along with their sources, manufacturing procedure, flowsheet(s) and assimilation in soil for important fertilizers include Ammonia, Urea, Calcium ammonium Nitrate, Calcium Cyanamide, diammonium hydrogen phosphate, Calcium superphosphate, Calcium triple superphosphate, potash fertilizers, Organic Compost.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Pulp and Paper Technology, Testing and Applications, K.P. Rao (2003), CBS Publishers.
3. Chemistry of Pulp and Paper making, Edwin Sutermeister, Ed-3<sup>rd</sup> (1946)
4. Fertilizers and Soil Fertility, U.S.Jones, Reston Publishing Co. Virginia, 1979.
5. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).
6. Shereve's Chemical Process Industries, 5th Ed.1975, by G.T.Austin, McGraw Hill Book Co. New York.

**APPLIED CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-474</b>
<b>Module title:</b>	<b>Applied Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

It will increase the practical handling of the students regarding analysis of sugar cane juice and liquid effluents from sugar industry

**SYLLABUS OUTLINE:**

Determination of Sucrose content in sugar cane juice by polarimetry and refractive index, Determination of reducing sugars, Determination of BOD, COD and DO in water bodies and industrial effluents, Determination of pH of soil, Determination of calcium in agricultural effluents.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Pulp and Paper Technology, Testing and Applications, K.P. Rao (2003), CBS Publishers.
3. Chemistry of Pulp and Paper making, Edwin Sutermeister, Ed-3<sup>rd</sup> (1946)
4. Fertilizers and Soil Fertility, U.S.Jones, Reston Publishing Co. Virginia, 1979.
5. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).
6. Shereve's Chemical Process Industries, 5th Ed.1975, by G.T.Austin, McGraw Hill Book Co. New York.

**APPLIED CHEMISTRY (BS-ADP 8<sup>th</sup>Semester)**

<b>Module Code:</b>	<b>Chem-475</b>
<b>Module title:</b>	<b>Textile Industries</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup>Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

Students will learn about the Textile processing; Synthesis of Fibers, finishing of fibers and dyeing of fibers. They will also learn about the synthesis to textile dyes.

**SYLLABUS OUTLINE:**

1. **Textile Fibers:**  
Classification of textile fibres, sources and properties of natural fibres, chemistry and manufacturing of Viscose rayon, Cellulose Acetate, Nylons and Polyesters and conversion to fibres, Finishing processes for 100% cotton fabrics such as singeing, desizing, scouring, mercerizing and bleaching
2. **Textile Dyeing:**  
Color and chemical constitution, Important classes of chromogens, Classification and nomenclature of dyes, manufacturing of dye intermediates and dyes, Selection of dyes for wool, cellulosic and synthetic fibers, Application methods of dyes to wool and cellulosic fibers.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Dyes and Dyeing, C.E. Pellow, Abhishek Publishers, 1998.
3. Textile Dyes and Pigments, H. Panda, NIIR Publishers.
4. Fibre to fabric, 4<sup>th</sup> Ed, Potter & Corban, McGraw Hill book Company, 1959.
5. Sugar: Science and Technology, G. G. Birch and K.. J. Parker, Applied Science Publishers Ltd., 1979.
6. Principles of Sugar Technology, Pieter Honig Vol I, Elsevier Publishing Company, 1953.

**APPLIED CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-476</b>
<b>Module title:</b>	<b>Applied Chemistry Lab - III</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

Students will understand about the Applications of Analytical techniques in chemical characterization of dyes. Also they will learn how to apply dyes to fabrics.

**SYLLABUS OUTLINE:**

Dyeing of clothes in different shades using Acid dyes, Determination of pK value of indicators (methyl orange and methyl red). Catalytic / photolytic degradation of Dyes. Removal of dyes from industrial effluents. Estimation of dyes by spectrophotometry.

**RECOMMENDED BOOKS:**

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Dyes and Dyeing, C.E. Pellow, Abhishek Publishers, 1998.
3. Textile Dyes and Pigments, H. Panda, NIIR Publishers.
4. Fibre to fabric, 4<sup>th</sup> Ed, Potter & Corban, McGraw Hill book Company, 1959.
5. Sugar: Science and Technology, G. G. Birch and K.. J. Parker, Applied Science Publishers Ltd., 1979.
6. Principles of Sugar Technology, Pieter Honig Vol I, Elsevier Publishing Company, 1953.

**APPLIED CHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-477</b>
<b>Module title:</b>	<b>Environmental Chemistry</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

The student will learn about the basic concepts of Environmental chemistry. They will also learn that how industrial activities contribute Water and Air Pollution.

**SYLLABUS OUTLINE:**

**1. Introduction:**

History and significance of environmental degradation, impact of the modern life-style on environmental quality, resource depletion, environmental pollution and its types, environmental education, Environmental management systems, institutions for the protection of environment, inter-disc nature of environmental studies, environmental segments and their interrelationships, Environmental quality standards (air, drinking water and wastewater).

**2. Air and Water Environment:**

Composition of atmosphere, temperature and pressure profile of different layers of the atmosphere, common air pollutants and their sources, greenhouse effect and global warming, stratospheric ozone depletion, Importance of water, BOD and COD, sources of water pollution (industrial, agricultural, municipal and natural), primary, secondary and advanced treatment of water.

**RECOMMENDED BOOKS:**

1. Kumar. Environmental Chemistry, Wiley Eastern, New Delhi.
2. J.W. Moore & E.M. Moore, Environmental Chemistry, Academic Press, New York.
3. S. K. Banerji, Environmental Chemistry, Prentice Hall, Delhi.
4. K. Banerji, Environmental Chemistry, Tata Publisher, Delhi.
5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.
6. Neil, P.O. Environmental Chemistry, Chapman, London.
7. Baird, C. Environmental Chemistry, Freeman, New York.

**BIOCHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-478</b>
<b>Module Title:</b>	<b>Lipids</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

After studying this course student will be able to understand lipids, classification and importance of lipids, significance of lipids in biological membranes, triglyceride metabolism, phospholipids metabolism, cholesterol metabolism and lipid transport in plasma.

**SYLLABUS OUTLINES**

Nature, structure and classification of lipids. Structure and chemical properties of triglycerides, phospholipids, glycolipids, sphingolipids and steroids. Lipids with specific biological activities. Acid value, Saponification value and Iodine value of lipids/fats. Properties of lipid aggregates: Micelles and Bilayers. Structure and function of prostaglandins. Structure and assembly of Biological membranes and membrane proteins. Fluid Mosaic model. The erythrocyte membrane. Digestion and absorption of Lipids. Detailed Synthesis and Oxidation of fatty acids. Involving of Acyl carrier protein and Carnitine carriers. Metabolism of essential fatty acids and their metabolic disorders. Control of fatty acid Metabolism. Ketone Bodies.

**RECOMMENDED BOOKS**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000  
Pub: worth Publishers
2. Biochemistry by Lubert Stryer(2006) Pub: Freeman andCompany
3. A biologist's guide to Principles and Techniques of Practical Biochemistry by Bryan L Williams and Keith Wilson Pub: Edward Arnold Ltd.
4. Immunology by J. Kuby 2nd ed. 1996 Pub: W. H. freeman and Co.
5. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.
6. Lippincott's Biochemistry by champ c; Harvey.R.A and Ferrie. D .R. 3<sup>rd</sup> edition., Pub: J. B. Lippincott company

**BIOCHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-479</b>
<b>Module Title:</b>	<b>Bio Chemistry Lab - I</b>
<b>Name of scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVE**

This study will assist students for qualitative and quantitative determination of different lipids. It will also help to extract lipids from animal and plant sources. Students will be able to learn acid value, saponification value and Iodine value of fats.

**SYLLABUS OUTLINES**

- Qualitative tests for lipids and fatty acids, sterols and phospholipids.
- Extraction and Thin layer chromatography (TLC) of Lipids from animal and plant sources.
- Acid value, saponification Value and Iodine Value of fats.

**RECOMMENDED BOOKS**

1. Modern Experimental Biochemistry by R. F. Boyer 3rd ed, 2000, Pub: Pearson Education Inc.
2. Practical clinical Biochemistry by Varley. Pub: CBS-ADP publisher
3. An Introduction to Practical Biochemistry by D. T. Plummer 3rd Ed. (1987) Pub: McGraw Hill
4. Fundamentals of Microbiology. By E. Aicamo 1994 Publisher; Benjamin- Cummings Publishing Co.
5. Varleys Practical Clinical Biochemistry 6th Edition (English, Hardcover, Alan H. Gowenlock)

**BIOCHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-480</b>
<b>Module Title:</b>	<b>Molecular Biology</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

After studying this course, students will be able to understand molecular biology, DNA as hereditary material, DNA replication, reverse transcription, DNA damage and repair. It will also assist to understand Transcription and Translation of DNA, machinery of protein synthesis and process of protein synthesis.

**SYLLABUS OUTLINES**

Introduction of molecular biology and history. DNA as genetic material. Chromatin and structure of Eukaryotic chromosomes, DNA replication and transcription in prokaryotes and eukaryotes. Translation; synthesis and splicing of RNA, Protein synthesis. DNA damage, repair and recombination. Restriction enzymes. Regulation of gene expression in prokaryotes, eukaryotes and Operon model. Plasmids, bacteriophages, and cosmids. Method of Recombinant DNA.

**RECOMMENDED BOOKS**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000Pub: worth Publishers
2. Biochemistry by Lubert Stryer (2006) Pub: Freeman and Company
3. A biologist's guide to Principles and Techniques of Practical Biochemistry by Bryan L Williams and Keith Wilson Pub: Edward Arnold Ltd.
4. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.
5. Lippincott's Biochemistry by champ c; Harvey.R.A and Ferrie. D .R. 3<sup>rd</sup> edition., Pub: J. B. Lippincott company
6. BRS Biochemistry, Molecular Biology,and Genetics 5th edition



**BIOCHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-481</b>
<b>Module Title:</b>	<b>Bio Chemistry Lab - II</b>
<b>Name of Scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

This course will help students to understand practical grounds to isolate DNA from animal and bacterial sources. It will also help students to understand the technique of gel electrophoresis.

**SYLLABUS OUTLINES**

- Preparation of stock and working solution for the isolation of DNA.
- Isolation of genomic DNA by inorganic method.
- Isolation of genomic DNA by organic method.
- Determination of messenger RNA expression of candidate gene by PCR.
- Determination of DNA, cDNA by gel electrophoresis.
- Separation of different spliced DNA by gel electrophoresis.
- Isolation and estimation of DNA from animal sources and bacteria.
- Restriction enzyme digestion of DNA and its separation by gel electrophoresis

**RECOMMENDED BOOKS**

1. Ausubel FM, 2005. Short Protocols in Molecular Biology (2 volume set). 5<sup>th</sup> Edition; John Wiley and Son.
2. Green MR and Sambrook J, 2001. Molecular Cloning: A Laboratory Manual. 3<sup>rd</sup> Edition; Cold Spring Harbor Laboratory Press.
3. Primrose SB and Twyman R, 2006. Principles of Gene Manipulation and Genomics. 7<sup>th</sup> Edition; Wiley-Blackwell.
4. Wilson K and Walker J, 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7<sup>th</sup> Edition; Cambridge University Press.
5. Walker JM and Rapley, 2008.

**BIOCHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-482</b>
<b>Module Title:</b>	<b>Microbiology &amp; Drug Metabolism</b>
<b>Name of scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

After studying this course, students will be able to understand development of drug resistance. Students will learn the mode of action of different drugs which in turn will help to understand physiology, biochemistry, and genetics of microorganisms.

**SYLLABUS OUTLINES**

Microorganisms and their gross Classification, Bacterial growth and cultivation techniques. Identification of Microorganisms, Factors for the growth of microbes. Methods of Growth measurement, Growth under extreme environments. Mutation and protoplast fusion in cultures and its benefits. Gene transfer: transformation, transduction and conjugation. Bacteriophages chemistry, metabolism and mechanism of action of anti-malarials, anti-bacterials, antivirals and antifungal drugs. Drug resistance, Biochemical transformation of drugs. Anticancer drugs.

**RECOMMENDED BOOKS**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000  
Pub: worth Publishers
2. Biochemistry by Lubert Stryer (2006) Pub: Freeman and Company
3. A biologist's guide to Principles and Techniques of Practical Biochemistry by Bryan L Williams and Keith Wilson Pub: Edward Arnold Ltd.
4. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.

**BIOCHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-483</b>
<b>Module Title:</b>	<b>Bio Chemistry Lab - III</b>
<b>Name of scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>1 credit</b>

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**OBJECTIVES**

This study will provide better understanding of sterilization techniques, bacterial culturing and understanding of bacterial growth curves by chemical tests. It will also help to understand the structure of cell.

**Syllabus Outlines**

- Study and practical demonstration of laboratory safety measures.
- Preparation of serial dilution from stock solution.
- Sterilization techniques, culturing of bacteria in liquid and solid medium, gram staining of bacteria, colony and cell morphology, bacterial cell count and growth curves by chemical tests.
- Isolation of bacteria.
- Growth of bacteria.
- Antibiotic sensitivity test.
- Activity of drug
- Cell structure: Study of cell structure by light microscope.

**RECOMMENDED BOOKS**

1. Modern Experimental Biochemistry by R. F. Boyer 3rd ed, 2000, Pub: Pearson Education Inc.
2. Practical clinical Biochemistry by Varley. Pub: CBS publisher
3. An Introduction to Practical Biochemistry by D. T. Plummer 3rd ed. (1987) Pub: McGraw Hill
4. Fundamentals of Microbiology. By E. Aicamo 1994 Publisher; Benjamin- Cummings Publishing Co.

**BIOCHEMISTRY (BS-ADP 8<sup>th</sup> Semester)**

<b>Module Code:</b>	<b>Chem-484</b>
<b>Module Title:</b>	<b>Biochemical Techniques</b>
<b>Name of scheme:</b>	<b>BS-ADP 8<sup>th</sup> Semester</b>
<b>Department:</b>	<b>School of Chemistry</b>
<b>Faculty:</b>	<b>Science</b>
<b>Module Type:</b>	<b>Compulsory</b>
<b>Module Rating:</b>	<b>2 credits</b>

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**OBJECTIVES**

After studying this course, students will be able to understand proteins extraction and purification techniques, chromatographic techniques, different biochemical techniques used for separation, types of PCR and its applications.

**SYLLABUS OUTLINES**

General methods for extraction, fractionation and purification of proteins. Principles of chromatography, ion exchange chromatography, paper chromatography, affinity chromatography, gas chromatography and column chromatography. High performance liquid chromatography (HPLC), Filtration, Polyacrylamide and agarose gel electrophoresis, SDS PAGE, Southern blotting, Western blotting, Northern blotting. Immunoelectrophoresis. Enzyme linked immunosorbent assay (ELISA) and its types, Radioisotopes and their applications in Biochemistry. PCR and its types,

**RECOMMENDED BOOKS**

1. Principles of Biochemistry by Lehninger AL, Nelson DL and CoxMN,2000  
Pub: worth Publishers
2. Biochemistry by Lubert Stryer (2006) Pub: Freeman and Company
3. A biologist's guide to Principles and Techniques of Practical Biochemistry by Bryan L Williams and Keith Wilson Pub: Edward Arnold Ltd.
4. Immunology by J. Kuby 2nd ed. 1996 Pub: W. H. freeman and Co.
5. Harpers Biochemistry, 27th ed. (2006) McGraw Hill Inc.
6. (Methods in Molecular Biology) - Histopathology (2014) [PDF] [UnitedVRG]