Semester-I
CH 91105: PHYSICAL CHEMISTRY

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives: This course covers the basic principles of physical chemistry which are fundamental to the understanding of physical and chemical processes. The students will acquire knowledge of:

- Symmetry elements, various operations, points groups and applications
- Rate equations and theories related to chemical kinetics and the mechanisms for the same
- Different laws of thermodynamics and various concepts of electro-chemistry
- Crystals, their structure, defects and the applications
- Various phenomena occurring at the surface of molecules/substrates

Course Outcomes: By the end of the course student will be able to:

CO1: apply the symmetry elements and point group for molecule.

CO2: comprehend fundamental knowledge in chemical kinetics with basics of order, molecularity and temperature effect.

CO3: interpret the Concept of adsorption, isotherms and laws of thermodynamics.

CO4: enrich various concepts of electrochemistry and solid state chemistry

CO5: solve the problem attribute to thermodynamics and electrochemistry

Course Contents: Theory-
UNIT I
Symmetry and Group Theory
Symmetry elements, Symmetry operations, Mathematical group, Classes, Subgroup, Multiplication Table, Symmetry Transformations, point groups, applications.

UNIT II
Chemical Kinetics and mechanisms of chemical reactions
Rate equation, rate constant, order and molecularity of various reactions, factors affecting rate of a reaction, methods of determining order of a reaction, mechanism of various reactions, Theories of reaction rates, Evaluation of thermodynamic parameters, Reactions in solutions and reactions in flow systems, Kinetics of fast reactions. Flow methods, pulse methods. Introduction to molecular reactions, dynamics, applications.

UNIT III
Surface chemistry
Concept of adsorption, Langmuir and Freundlich theories for adsorption, Gibbs adsorption isotherm, multilinear adsorption- B.E.T theory, surface active agents, classification, micellization and Critical Micell Concentration (CMC), Factors affecting CMC, Solubilization, types of micelles and applications of adsorbent and micelles.

UNIT IV
(a) Electro chemistry

Introduction, electrode potential, chemical and concentration cell, EMF, its applications and measurements, Ion selective electrodes, sensors.

(b) Solid State Chemistry

Crystals, Laws of Symmetry: Miller and Wise indices, Crystal lattices, Crystals and X-rays, XRay spectroscopy, Crystal Structure. Defects in stoichiometric & non-stoichiometric crystals, applications.

UNIT V

Thermodynamics

First and Second laws of thermodynamics, derivations based upon them. Reversible and irreversible processes, Gibbs-Helmholtz equation and its various applications. Molecular dynamics, Statistical thermodynamics- Maxwell-Boltzmann, Fermi-Dirac and Monte-Carlo.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Books & References Recommended:

Text Books Recommended:

1. Gurdeep Raj, Advanced Physical Chemistry (Goel Publishing).
2. Kapoor K.L., A Text book of Physical Chemistry, Vol-I, Vol-II (McGraw Hill publishers).

Reference Books:

1. Bajpai D.N., Advanced Physical Chemistry (S. Chand Publishing).
2. Rastogi R.P. & Mishra R.R., An Introduction to Chemical Thermodynamics (Vikas Publishing House Pvt. Ltd.).
3. Chandra A.K., Introduction to Quantum Chemistry (McGraw Hill publishers).
4. Glasstone S., Thermodynamics for Chemist (East-West Press Pvt. Ltd.).
5. Glasstone S., Text Book of Physical Chemistry (D. Van-Nostrand Company).
6. Levine A., Text book of Physical Chemistry , (McGraw Hill publishers)

Journals:

1. Catalysts and Catalysed Reactions
2. Journal of Physical Chemistry C
3. Journal of Chemical Thermodynamics
4. Progress in Solid State Chemistry
5. Journal of Chemical Thermodynamics

M.Sc. Applied Chemistry
Semester-I
CH 91106: INORGANIC CHEMISTRY

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
4			4			CW	End Sem	SW	End Sem	
-	-	-	-			30	70			100

Pre-requisite: Nil
Course Objectives:The objective of this course is to develop an understanding of structure, bonding and reaction mechanisms in inorganic compounds focusing on coordination chemistry. The course will stimulate interest of students in following areas:

- Classical and wave mechanical approach to chemical bonding
- Concepts of acid-bases
- Coordination chemistry
- Chemistry of trans-uranium elements

Course Outcomes: By the end of the course student will be able to:

CO1: explain the concept of bond formation, types of bond, structure of complexes etc.

CO2: illustrate the bonding in Hydrides and metal Carbonyls.

CO3: predict working with non-aqueous solvents.

CO4: recall the theories of coordination chemistry and stereochemistry.

CO5: explain the properties and applications of inner transition element and nano chemistry.

Course Contents: Theory-
UNIT I
Chemical Bonding:
(a) Classical approach: Earlier theories and Modern concepts, Fajan's rules. (b) Wave Mechanical concept: Valence bond and Molecular orbital theory, VSEPR theory, Metallic bond, Band gap theory.

UNIT II
Types, Bonding , Classification, methods of preparation, chemical properties and applications of the following: **Hydrides and metal Carbonyls, Organometallics in Homogeneous Catalysis**

UNIT III
(a) Modern concept of acids and bases.
(b) Reaction in non-aqueous solvents, viz. liquid ammonia, sulphur dioxide and hydrofluoric acid.

UNIT IV
Coordination chemistry
Coordination compounds and their theories, structure of complexes, Chelation, Stability constants and their determination, Application of complexes. stereo chemistry & reaction mechanism, Introduction to Bioinorganic chemistry.

UNIT V
(a) Inner Transition Elements: Spectral and Magnetic Properties.
(b)Nano chemistry: elementary idea and its applications.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Books & References Recommended:

Text Books Recommended:

1. Prakesh S., Tuli G.D., Basu S.K. and Madan R.D., Advanced Inorganic Chemistry Vol.- I & II (S.Chand)
2. Gurdeep Raj, Advanced Inorganic Chemistry (Goel Publishing)

Reference Books:

1. Moeller T., Inorganic Chemistry.(John Wiley & Sons)
2. Gilreath ES, Fundamental Concepts of Inorganic Chemistry (Mc-Graw- Hill).
3. Atkin P., Inorganic Chemistry (Oxford press).
4. Huheey JE, Keiter EA, Kieter RL, Medhi OK, Inorganic chemistry (Pearson Publishing)
5. Satya Prakash, Advanced Chemistry of Rare Elements (S. Chand).
6. Bhattacharaya PK, Bioinorganic Chemistry, PHI Learning.

Journals:

1. Bio organic & Medicinal Chemistry,Journal - Elsevier
2. Inorganic Chemistry,ACS Publications
3. Journal of Coordination Chemistry,Taylor and Francis
4. Synthesis and Reactivity in Inorganic, Metal-Organic and Nano-Metal Chemistry,Tylor and Francis
5. Rare Metals, Springer

M.Sc. Applied Chemistry
Semester-I
CH 91107: ANALYTICAL CHEMISTRY

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives:This course covers the fundamental concepts of various analytical techniques used with a view to understand the principles, instrumentation and application. The student will acquire knowledge of:

- Organic reagents used in analysis
- Techniques like colorimetry, polarimetry, conductometry, pH metry and polarography, thermogravimetric analysis, differential thermal analysis and flame photometry
- Chromatographic and membrane separation techniques
- Application of optical rotatory dispersion (ORD) and circular dichroism (CD) for quantitative analysis of organic molecules

Course Outcomes: By the end of the course student will be able to:

CO1: develop qualitative and quantitative skills needed in application of analytical chemistry.

CO2: recall fundamental principles of colorimetry , polarimetry, and polarography.

CO3: evaluate the spectral properties of instruments such as UV-Visible Spectrometer, Colorimeter etc.

CO4: recall principle and fundamentals of the various chromatographic technique

CO5: estimate ORD, CD, thermogravemetric and flame photometry techniques for analysis of organic molecules.

Course Contents: Theory-
UNIT I
Types of Analytical Techniques, Qualitative and Quantitative Analyses, Data Analyses and Interpretations, Errors and Limits

UNIT II
(a) Fundamental Principles of Spectroscopy :
Electromagnetic radiation: Definition, wave properties and parameters, electromagnetic spectrumspectroscopic methods in each region, types of spectra and interaction mechanisms.
(b) UV & **Visible Spectroscopy**
Types of absorption bands, empirical rules for predicting the onward wave-length of absorption peaks. Visible spectrometry and its advantage over colorimetry, instrumentation, sample handling Applications of UV-Visible spectroscopy.

UNIT III
Principle, instrumentation and applications of the following:
(a) Colorimetry
(b) Polarimetry
(c) Conductometry
(d) pH metry

(e) Polarography

UNIT IV
Principle, separation techniques, chromatography column, paper, VPC, GC, GLC HPLC, Ion-pair Chromatography, Electrophoresis. Membrane separation techniques bio-separation.

UNIT V
(a) ORD and CD: Fundamental principles, measurements, cotton effect, molecular amplitude, birefringence, refractive indices, application of ORD and CD for quantitative analysis of organic molecules, Octant Rule, Halo Ketone Rule.
(b) Principle, Instrumentation and applications of the following techniques: Thermogravimetric analysis, Differential Thermal Analysis, Flame Photometry

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Books & References Recommended:

Text Books Recommended:

1. Sharma, B.K. Instrumental methods of analysis (Krishna Prakashan Media)
2. Willard, Merritt Dean & settle, Instrumental Methods of Chemical Analysis (Van Nostrandor 7th Ed.)

Reference Books:

1. Shrivastav A.K., Jain P.C., Instrumental Approach to Chemical Analysis (S. Chand & Company)
2. Ewing G.W., Instrumental Methods of Chemical Analysis (McGraw -Hill)
3. Skoog D.A. and West DM, Fundamental of Analytical Chemistry (Saunders College Publishing)
4. Sivashankar B., Bio separation, (PHI learning publishing)
5. Skoog DA, Holler F J, Crouch RS, Principles of Instrumental Analysis (Brooks Cole; 6 edition)
6. Vogel A.I., Quantitative Chemical analysis (Longman Scientific and Technical Publisher)

Journals:

1. Analytical and Bioanalytical Chemistry,Springer
2. Analytical Chemistry,ACS Publications
3. Journal of Solution Chemistry, Springer
4. Inorganic, Physical, Theoretical and Analytical Chemistry,Indian Journal of Chemistry
5. Journal of the Indian Chemical Society

M.Sc. Applied Chemistry
Semester-I
CH 91108: CHEMISTRY OF ENGINEERING MATERIALS

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives: This course emphasizes the role of chemistry in the field of engineering. The focus is on the characterization and application of various materials in engineering. The course will enable student to

- Understand the implications of hard water in industry and its treatment
- Understand the concept of corrosion and their protection
- Analyze the use of different types of composite, polymers, fuels, lubricants, refractory, cement and mortar in industry.
- Consider the environmental aspects of industrial processes elements

Course Outcomes: By the end of the course student will be able to:

CO1: apply Specifications, testing and treatment of water for industrial and domestic use.

CO2: recall the different types fuels used in combustion and illustrate the combustion in the internal combustion engines.

CO3: illustrate Concepts, manufacturing and applications of different types of industrially important materials such as lubricants, refractory and corrosion.

CO4: categorize polymerization reactions with respect to mechanisms and distinguishes differences of these reactions.

CO5: enrich the knowledge on themes of biodiversity, natural resources, pollution control & waste management.

Course Contents: Theory-

UNIT I
Water treatment
Source, Types of impurities and their effects, Hardness, its expression and determination, Boiler troubles and their causes, treatment of water industrial and domestic purposes, Alkalinity and its determination, Numerical problems. Effect of impurities in water used in different industries, eg. steam generation, textile industries, leather tanning, paper etc., IS specifications for portable water.

UNIT II
Fuels
Classification, calorific value & its determination, analysis of solid fuel, pulverized coal, carbonization of coal, criteria of metallurgical coke, manufacture of coke. Petroleum distillation cracking, cracked and synthetic gasoline, knocking, anti knocking compounds, power alcohol, Gaseous fuels- natural gas, LPG, coal, gas, producer gas, water gas, carbureted water gas, introduction to nuclear fuels, numerical problems based on combustion and calorific value.

UNIT III
(a) Lubricants

Principles of lubrication, study of solid, semi solid, liquid and synthetic lubricants, lubricating emulsions, properties and selection of lubricants.
(b) Corrosion Introduction, theories of corrosion, Factors affecting rate of corrosion,protection against corrosion, types of corrosion

UNIT IV
(a) Polymers Classification of polymers, types of polymerisation, mechanisms, structure-property relationships, polymer materials of industrial importance - plastics, rubbers and synthetic fibres.
(b) Cement & **Mortars** Portland cement, composition, specifications, manufacture, setting, lime and mortars, testing of cement, cementing materials and puzzolana cement (c) Chemistry and manufacture of silicates, porcelains and glasses

UNIT V
(a) Environment and Pollution: Environment, pollution of atmosphere, hydrosphere and lithosphere, process of its control. Chemistry for green environment- basic concepts and significance
(b) Refractories : Classification, chemical composition, properties of Acidic, Basic and Neutral refractories, testing of refractories, application in industries.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Books& References Recommended:
Text Books:

1. Palanna O.P., Engineering Chemistry(Mc Graw Hill)
2. Rajaram & Kuriacose, Chemistry in Engineering and Technology Vol.-II (Mc Graw Hill.)

Reference Books:

1. D. Braun, Polymer Synthesis: Theory & Practice:Fundamentals,Methods, Experiments (Springer).
2. De A.K., Environmental Chemistry (Pearson Education).
3. Ambasta B.K., Chemistry for Engineers(University Science Press).
4. Dara S.S., Engineering Chemistry (S. Chand publishing).
5. Agrawal C.V., Chemistry of Engineering Materials. (B.S. Publications)
6. Maheswaramma K.S., Engineering chemistry (Pearson Education)

Journals:

1. E-Polymers
2. High Energy Chemistry
3. Journal of Fuel Chemistry and Technology
4. Corrosion science and 5. Journal of ceramic processing research

M.Sc. Applied Chemistry
Semester-I
CH 91173: PHYSICAL CHEMISTRY AND MATERIALS LAB

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
-	8	-	-	4	-	-	-	40	60	100

Pre-requisite: Nil
Course Objectives:This course will illustrate the principles of chemistry relevant to the study of science and engineering. The students will learn to:

- Determine properties of lubricants and oil samples
- Analyze water in terms of hardness, chloride content and alkalinity

Laboratory Outcomes: By the end of the course student will be able to:

LO1: analyze experimentally about the partition coefficient, heat of neutralization and Adsorption isotherm.

LO2: evaluate Transition temperature, Velocity constant and Solubility curve of compounds.

LO3: determine flash point and viscosity of oil samples.

LO4: evaluate Total solids in water sample and Percentage of moisture in a coal sample.

LO5: estimate the hardness, chloride and alkalinity of water sample.

Course Contents: Practical-

List of Practical's- Determination of the following:

1. Partition coefficient for Iodine in CCl4/H2O system.
2. Partition coefficient for Benzoic acid in Benzene/H2O system.
3. Heat of neutralization.
4. Adsorption isotherm for oxalic acid on activated charcoal
5. Solubility curve of Phenol/H2O system.
6. Transition temperature of Strontium Chloride.
7. Velocity constant of alkaline hydrolysis of ethyl acetate.
8. Flash point by Abel's apparatus.
9. Flash point by Pensky Martin's apparatus.
10. Redwood viscosity by viscometer no. 1
11. Redwood viscosity by viscometer no. 2
12. Total solids in water sample.
13. Percentage of moisture in a coal sample.
14. Total hardness of water sample by Ethylene di amine tetra acetic acid(EDTA) method.

15. Carbonate, bicarbonate and total alkalinity of water sample.
16. Free chloride in water sample.

Assessment: Term end practical exam and Comprehensive viva-voice

Text Books:

1. Practical engineering chemistry, S. S. dara , S chand Publishing
2. Advanced practical physical chemistry, J. B. Yadav , Krishna
3. Laboratory manual on engineering chemistry, S. K . Bhasin, Sudha Rani, Dhanpat rai Pub.

Reference Books:

1. Practical Aspects of Chemical Engineering, Springer
2. Practical Physical Chemistry, Arthur A. Vernon, Sixth edition (Findlay, Alexander)

M.Sc. Applied Chemistry
Semester-I
CH 91174: INORGANIC CHEMISTRY LAB.

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
-	8	-	-	4	-	-	-	40	60	100

Pre-requisite: Nil
Course Objectives: This course will illustrate the principles of chemistry related to inorganic chemistry. Students will learn :

- Quantitative analysis of radicals (anions and cations) in various inorganic mixture.
- Gravimetric sand volumetric analysis of alloys
- Preparation of inorganic double salts.
- Quantitative estimation of engineering material

Laboratory Outcomes: By the end of the course student will be able to:

LO1: prepare how to prepare inorganic complexes in the laboratory.

LO2: analyze qualitatively mixture of Inorganic salts containing seven radicals.

LO3: evaluate Gravimetric and volumetric analysis of alloys.

LO4: prepare various inorganic complexes.

LO5: analyze quantitatively limestone and cement.

Course Contents: List of Practical-

1. 1. Qualitative analysis of mixture of Inorganic salts containing seven radicals out of the following:
   Cations:
   (a) Pb^{2+}, Ag^{+}, Hg^{+}
   (b) $Cu^{2+}, Bi^{3+}, Hg^{2+}, As^{3+}, Sb^{2+}, Sn^{2+}$
   (c) $Fe^{3+}, Al^{3+}, Cr^{3+}$
   (d) $Ni^{2+}, Co^{2+}, Zn^{2+}, Mn^{2+}$
   (e) $Ca^{2+}, Sr^{2+}, Ba^{2+}$
   (f) Mg^{2+}, NH_4^{+}

   Anions:
   (a) $CO_3^{2-}, SO_3^{2-}, S^{2-}, CH_3COO^{-}, NO_2^{-}$
   (b) $Cl^{-}, Br^{-}, I^{-}, NO_3^{-}, SO_4^{3-}$
   (c) $PO_4^{3-}, BO_3^{3-}, C_2O_4^{2-}$
2. Gravimetric and volumetric analysis of alloys for at least two metals
3. Preparation of Chrome Red
4. Preparation of Cuprammonium sulphate

5. Preparation of Mohr's salt
6. Preparation of Potash Alum
7. Preparation of Chrome Alum
8. Quantitative analysis of limestone and cement

Assessment : Term end practical exam and comprehensive viva-voice.

Text Books:

1. Practical Inorganic Chemistry, Gurdeep raj , Krishna Publishing
2. practical Inorganic chemistry, Shikh Gulati , CBS Publishing
3. Theoretical and Inorganic Chemistry (Theory) & Volumetric Analysis-II (Practical), Anu Gopianth , Vishal Publishing

Reference Books:

1. Practical Inorganic Chemistry: Preparations, Reactions and Instrumental Methods.
2. Geoffrey Pass and Haydn Sutcliffe, Chapman and Hall Publishing Vogel's Qualitative Inorganic Analysis 5th Ed.

M.Sc. Applied Chemistry
Semester-II
CH 91205: ORGANIC CHEMISTRY

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives: This course covers the fundamental aspects of organic chemistry i.e. factors, effects, models, selectivity, conformation, and stereochemistry of molecules. Emphasis is on gaining ability and understanding of reagents, mechanisms, photochemistry and synthesis through problem-based case-studies and tests. The course will enable student to:

- Identify chiral center in the given organic compounds, define erythro, threo, meso, diasteroisomers with suitable examples and find R/S configuration in compounds.
- Conceptualize the structure and reactivity of organic molecules which will help in understanding of the reaction mechanisms with emphasis on some name reactions.
- Draw the various conformers of cyclic and acyclic molecules and explain their stability
- Apply the disconnection approach to provide the retrosynthetic routes for molecules.
- Rationalize the use of different reagents for target molecule synthesis
- Understand the importance of photochemistry and pericyclic reactions

Course Outcomes: By the end of the course student will be able to:

CO1: apply the stereochemical implications and conformations analysis of organic compounds

CO2: interpret and analyze reactions having different functionalities and rearrangements.

CO3: use the concept of Disconnection approach and asymmetric synthesis.

CO4: apply the use of modern reagent for various reactions.

CO5: relate the concept of aromaticity and photochemistry.

Course Contents: Theory-
UNIT I
(a) Stereochemistry
Stereochemistry of carbon compounds, optical and geometrical isomerism, isomerism of Diphenyls, Allenes and Spiranes
(b) Conformational Analysis
Theory and stability of cyclic and acyclic compounds: Ethane,Butane, cyclopentane, Cyclohexane, and their substituted derivatives.

UNIT II
(a) Types and Mechanisms of Substitution, Elimination and Addition Reactions, Methods for determining mechanism of reaction
(b) Reactive intermediates: (Carbenes and Nitrenes) and their reactions **(c) Molecular Rearrangements:** Pinacol-Pinacolone, Beckmann, Lossen, Schmidt, Hofmann, Curtius, Baeyer-Villiger, Fries, Favroskii and Wittig, Walden inversion.

UNIT III

Disconnection approach
An introduction to synthesis and synthetic equivalents, Disconnection approach, functional group inter conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, reversal of polarity, protection of groups, Asymmetric synthesis.

UNIT IV
(a) Modern reagents in organic synthesis:
Metal hydrides, organic peroxides, peracids, boron trifluoride, ozone, lead tetra-acetate, selenium dioxide, N-Bromo succinimide, Diazomethane, Diazoacetic ester, Osmium tetraoxide, and trifluoroacetic acid, DCC.
(b) Organometallic compounds of Al, Li, Mg and Cu and their applications in organic synthesis.

UNIT V
(a) Aromaticity
Aromaticity of benzenoid and non-benzoid compounds, Huckel's Rule, Anti-aromaticity, Homoaromaticity.
(b) Organic photochemistry
Jablonski's diagram, Norrish type I and II reactions **(c)Pericyclic Reactions :** Symmetry of Orbitals, Electrocyclic reactions, Cycloaddition reactions and sigmatropic rearrangements.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Books & **References Recommended :**
Text books:

1. Finar I.L., Organic Chemistry Vol. I & II.(ELBS and Longman Ltd. New Delhi)
2. Morrison and Boyd, Organic Chemistry. (Prentice-hall Publishing)

Reference books:

1. Eliel E.L., Stereo chemistry of Carbon Compounds (Mc Graw Hill.)
2. March J, Structure Reactions and Mechanism. (John Wiley & Sons,New York)
3. Kalsi P.S., Stereochemistry of Organic Compounds.(New-Age International Pub;New Delhi)
4. Mukherji S. M. & Singh S.P. Reactions and Mechanism in Organic Chemistry.(Macmillan India)
5. Clyden and Greeves, Organic chemistry, Oxford university press.
6. Peter Sykes, Structure and Mechanism in Organic Chemistry (Orient Longman Ltd;New Delhi)

Journals:

1. THEOCHEM
2. RSC Advances
3. Molecular Biosynthesis
4. Organic Letters
5. Chemical Reviews
6. European Journal of Organic Chemistry
7. Resonance-Journal of Science Education, Indian Academy of Sciences
8. The Journal of Organic Chemistry - American Chemical Society

M.Sc. Applied Chemistry
Semester-II
CH 91206: MODERN ANALYTICAL METHODS

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives:This course introduces the students to important spectroscopic techniques used for characterization of molecules. The course will stimulate interest of students in following areas:

- Fundamentals of spectroscopy
- Interpretation of structure of molecules on basis of their UV-vis, IR, NMR, and mass spectra.
- Theory and applications of Raman, laser and atomic absorption spectroscopy

Course Outcomes: By the end of the course student will be able to:

CO1: apply the knowledge of sampling, data analysis, interpretation and select proper analytical method.

CO2: explain the principles of IR and Raman spectroscopy.

CO3: interpret and analysis the molecular structure by NMR spectroscopy.

CO4: apply the knowledge of Mass spectroscopy for structure elucidation.

CO5: explain the principles of ESR spectroscopy.

Course Contents: Theory-
Unit-I
(a) IR Spectroscopy
Introduction and theory, types of vibrations, theoretical and observed number of modes, intensity of absorption bands, group frequencies, finger print regions, factors affecting group frequencies and band shapes, Vibrational & Rotational fine structures. Instrumentation and Applications, Introduction to Fourier transform IR spectroscopy.
(b) Raman Spectroscopy
Introduction and theory, Advantages of Raman spectroscopy over IR spectroscopy. Correlation between IR and Raman Spectra. Factors affecting the choice between IR and Raman spectra. Instrumentation and Applications of Raman Spectroscopy.

Unit II
NMR Spectroscopy
Introduction, theory of magnetic and nuclear resonance, magnetic shielding and chemical shift, spin-spin interactions, coupling constants, splitting pattern, nature of coupling, rules for predicting band multiplicities, spin decoupling, shift reagents, instrumentation, sample handling, applications-structure elucidation, qualitative and quantitative analysis, kinetic studies, property studies. NMR spectra of nuclei other than protons, 13C, 31P, 19F & 14N. Applications

Unit III
Mass Spectroscopy
Introduction, principles, instrumentation and applications of mass spectrometry(EI- MAS, FAB, ESI)

Unit IV
(a) ESR Spectroscopy

Introduction, theory, intensity and width, position and multiplet structure of spectral lines, instrumentation and applications.

(b) Laser Spectroscopy

Introduction, basic principles, instrumentation and applications.

Unit V

Atomic Spectroscopy

Theory of atomic absorption spectroscopy (AAS) instrumentation, general methodology of AAS, Preparation of samples, applications of AAS in environmental science and engineering, analytical chemistry, ICPES, Flame photometry and AAS.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Books & References Recommended:

Text books:

1. Banwell C.N., Mc Cash E.M., Fundamentals of Molecular Spectroscopy (McGraw Hill Education)
2. Ewing G.W., Instrumental Methods of Chemical Analysis (McGraw Hill Education).

Reference books:

1. Silverstein R.M., Spectrometric Identification of Organic Compounds (J. Wiley & Sons, New York).
2. William D., Fleming I., Spectroscopic Methods in Organic Chemistry (McGraw Hill Education).
3. Shrivastav A.K., Jain P.C., Instrumental Approach to Chemical Analysis (S. Chand & Company).
4. Sharma B.K., Instrumental Methods of Chemical Analysis (Krishna Prakashan Media).
5. Sharma Y.R., Elementary Organic Spectroscopy (S. Chand and Company).
6. Kalsi P.S., Spectroscopy of Organic Compounds (New Age International Publisher).

Journals:

1. Concepts in Magnetic Resonance Part B: Magnetic Resonance Engineering
2. International Journal of Mass Spectrometry
3. Journal of Electron Spectroscopy and Related Phenomena
4. Journal of Molecular Spectroscopy
5. Journal of Applied Spectroscopy

M.Sc. Applied Chemistry
Semester-II
CH 91207: NATURAL PRODUCTS

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives:This course introduces the students to major classes of biomolecules such as vitamins, carbohydrates, lipids, terpenoids, carotenoids and pophyrins. Importance is given on the structural and functional aspects of these molecules. The course will enable student to:

- Know different biomolecules.
- Appreciate the role of biochemistry in the day to day life.
- Write the various projections of carbohydrates and explain their optical activity
- Synthesis of several biomolecules.

Course Outcomes: By the end of the course student will be able to:

CO1: elucidate the biosynthetic pathways to prepare water and fat soluble vitamines.

CO2: analyze the factors affecting the biosynthesis of secondary metabolites and apply the concept to improve the yield

CO3: design the appropriate strategy to isolate and characterize different class of natural products.

CO4: identify industrially relevant method for quantification of different class of natural products.

CO5: express the concept of secondary metabolites and their biosynthetic pathways.

Course Contents: Theory-
Introduction, classification, occurrence, isolation, synthesis, biological significance and constitution of:

Unit I
Water soluble vitamins Vitamin B-Complex, thiamine, riboflavin, pyridoxine, niacin, pantothenic acid, folic acid, inositol, B12, biotins, vitamin-C.

Unit II
Fat-soluble vitamins : Vitamin - A, D, E & K.

Unit III
(a) Carbohydrates
Structure determination of glucose, fructose, sucrose, cellulose and starch.

(b) Glycosides- Cardiac glycosides.

(c) Lipids
Properties, constitution and uses of simple and compound lipids and waxes.

Unit IV
Terpenoids

Terpenoid compounds, isoprene & special isoprene rule, composition and properties of common essential oils, citral, citronellol, geraniol, linalool, limonene, terpeneol, carvone, thymol, menthol, pinene, camphene, camphor, farnesols, zingiberene and bisabolene

Unit V
(a) Carotenoids
Carotene, alpha -carotene, beta-carotene, lycopene. **(b) Porphyrins**
Porphin derivatives, their stability and synthesis, constitution of haemin, biological significance of haemin.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Text Books Recommended :

1. Agrawal O.P. Chemistry of natural products Vol I & II (Goel Publishing House)
2. Chatwal G.R. Chemistry of natural products Vol I & II (Himalaya Publishing House).

Reference Books:

1. Finar I. L. Organic Chemistry Vol. I & II.(ELBS and Longman Ltd. New Delhi)
2. Sewald N, Jakubke HD Peptides: Chemistry and Biology. Wiley-VCH publisher.
3. Thisbe K. Lindhorst, Essentials of Carbohydrate Chemistry & Biochemistry (Wiley publisher).
4. Li J.J., Corey E.J., Total Synthesis of Natural Products: At the Frontiers of Organic Chemistry (Wiley publisher).
5. Dewick P.M., Medicinal natural products (Wiley publisher).
6. Robyt, John F., Essentials of Carbohydrate Chemistry (Springer).

Journals:

1. Journal of Natural Products - ACS Publications
2. Indian Journal of Natural Products and Resources
3. Journal of Asian Natural Products Research
4. journal of natural medicine
5. Cholesterol — An Open Access Journal

M.Sc. Applied Chemistry
Semester-II
CH 91209: CHEMISTRY OF DRUGS - I

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives:This course introduces the students to major classes of drugs and therapeutic agents. The focus is on the preparation, applications and structure-activity relationship of biologically active molecules. The course will stimulate interest of students in following areas:

- Drug intermediates and fine chemicals
- Antiseptic, antifungal, antitubercular, sulphadrugs, anthelmintic, antiprotozoals and sulphadrugs
- Drugs derived from various heterocycles

Course Outcomes: By the end of the course student will be able to:

CO1: apply the mechanistic pathways of different class of medicinal compounds.

CO2: predict the chemistry of drugs with respect to their pharmacological activity.

CO3: develop the capability to analyze the dose & route of administration of antiseptics , anti fungal & anti protozoal drugs.

CO4: identify dose, route of administration, precautions, & contraindications of diuretics & sulpha drugs.

CO5: illustrate the importance of heterocycles, learn the properties and synthetic routes of various transformations involving heterocycles.

Course Contents: Theory-
Unit I
(a) Introduction to drugs, classification and theories of action of drugs, structure and activity, drug metabolism, mechanism of drug action, bioavailability, drug distribution and elimination, toxicity, drug interactions.
(b) Organometallic Therapeutic Agents : Preparation, properties and uses of organometallic compounds of As, Sb, Bi, Au and Hg.

Unit II
(a) Drug Intermediates
Preparation, properties and synthetic applications of barbituric acid, carbazoles, ethyl acetoacetate, succinic anhydride, phenyl acetic acid, hydroxyl amine hydrochloride, acetoxime, acetanilide, benzanilide, 2-amino-pyridine, o & p amino-phenols, p amino benzoic acid.
(b) Fine Chemicals
Preparation, Properties and Synthetic applications of Salicylates (methyl, ethyl, phenyl, mercury and lithium) citrates, tartrates, diethyl malonate, aluminium hydroxide gel, glycerophosphates, menthol crystals, benzocaine.

Unit III
Pharmaceuticals Preparation (if possible manufacture) properties, mode of action, structure-activity relationship and uses.
(a) Antiseptics

Alcohols, phenols and their derivatives, Povidone Iodine, nitrofurazone, halazone, chloroazodin, medicinal dyes : Gentian violet, basic fuschin, acridine derivatives, methylene blue.

(b) Antifungal Drugs

Propionic acid, salicylic acid and their derivatives, tolnaftate, chlordantoin, clotrimazole, miconazole.

(c) Antitubercular Drugs

Aminosalicylic acid and its derivatives. Isoniazid, Pyrazinamide, ethambutol, ethionamide.

Unit IV

Pharmaceuticals Preparation (if possible manufacture) properties, mode of action, structure-activity relationship and uses.

(a) Sulphadrugs

Sulphanilamide, sulphadiazine, sulphamerazine, sulphamethazine, sulphapyrazine, sulphapyridine, sulphaguanidine, sulphathiazoles, sulphapyrimidine, sulphacetamide.

(b) Anthelmintics

Piperazines, pyrantel pamoate, mebendazole, thiabenzadole.

(c) Antiprotozoals

Metronidazole, diethyl carbamazine citrate, quinoline derivatives, Chloroquine and Pamaquine phosphate, furazolidone.

Unit V

Heterocyclics

Preparation, properties and uses of two drugs derived by each of the following : thiazoles, pyrazoles, pyrimidines, pyrans, indoles, carbazoles, isoquinolines.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weight-age is 70%.

Books & References Recommended :

Text Books:

1. Wilson & Gisvold, Organic Medicinal and Pharmaceutical Chemistry.
2. Ashutosh Kar Medicinal Chemistry.(Wiley Eastern Ltd, New Delhi)

Reference Books:

1. John A. Joule, Keith Mills , heterocyclic chemistry, Wiley publisher.
2. Berger, Medicinal Chemistry.(Wiley Interscience Pub. New york)
3. Lednicer D. & Lester A. Mitscher, Organic Chemistry of Drug Synthesis. (Wiley)
4. William Foye, Principles of Medicinal Chemistry. (Lea & Febiger Pub. House, Bombay
5. Raj K Bansal, Heterocyclic chemistry, (News Age publisher).
6. Dewick P.M., Medicinal natural products (Wiley publisher).

Journals:

1. The Journal of Antibiotics - Nature
2. The Journal of Infectious Diseases
3. Eco-Friendly Synthesis of Fine Chemicals
4. Antiseptics
5. Journal of Heterocyclic Chemistry

M.Sc. Applied Chemistry
Semester-II
CH 91273: ORGANIC CHEMISTRY AND DRUGS LAB-I

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
-	8	-	-	4	-	-	-	40	60	100

Pre-requisite: Nil
Course Objectives:This course will illustrate the principles of chemistry related to organic and drugs chemistry. Students will learn to:

- Determine the percentage of organic compounds in respective organic formulations.
- Quantitative analysis of various organic functional groups in organic compounds.
- Preparation of organic compounds using single and three step process.
- Extract various natural products using chemical processes.

Laboratory Outcomes: By the end of the course student will be able to:

LO1: illustrate Theoretical aspects of separation for multi components analysis.

LO2: apply practical skills for the analysis of drugs and excipients using various instrumentation techniques.

LO3: report accurate analysis and report the results in defined formats.

LO4: learn documentation and express the observations with clarity.

LO5: apply the professional and safety responsibilities for working in the analysis laboratory.

Course Contents: List of Practicals-

1. Determination of percentage of Acetyl salicylic acid in Asprin.
2. Determination of percentage of formaldehyde w/w in formalin.
3. Estimation of glucose using Fehling's solution.
4. Estimation of glycine by formal titration.
5. Oil analysis : (a) determination of acid value(b) Saponification No. (c) Iodine value
6. Quantitative analysis of binary organic mixture, separation, isolation and identification of following classes of organic compounds: (a) Acids (b) Alcohols (c) Hydrocarbons (d) Aldehyde and Ketones (e) Esters (g) Amines (I) Nitro compounds (j) Carbohydrates
7. Organic preparation :
   (a)) Single step preparations:
      i. Phenyl- Azo-Beta- Napthol
      ii. Napthol
      iii. Aspirin
      iv. Phthalimide
   (b) Three- step preparations:

i. Ortho- Chloro benzoic acid
ii. Para amino aniline
iii. Orange red dye

8. Extraction of alkaloids from natural sources.
9. separation and identification of amino acids, carbohydrates and phenyl hydrazones by TLC.

Assessment : Term end practical exam and comprehensive viva-voice.

Text Books:

1. Practical Organic Chemistry, O P Agrawal, Krishna Publishing
2. Advanced Practical Organic Chemistry, 3rd Edition, John Leonard, Barry Lygo, Garry Procter
3. Advanced Practical Organic Chemistry, R K Bansal, Tata McGraw Hill Publications

Reference Books:

1. Advanced Practical Organic Chemistry, Third Edition John Leonard, CRC Press
2. Vogels Practical Organic Chemistry, Ethyl Sulfate. Uploaded by. Joan Mas Torrent. Mann.

M.Sc. Applied Chemistry
Semester-II
CH 91274: MODERN ANALYTICAL METHOD LAB.

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
-	8	-	-	4	-	-	-	40	60	100

Pre-requisite: Nil
Course Objectives: This course will illustrate the principles of chemistry relevant to study of physical chemistry and spectroscopy. Students will learn:

- Determination and verification of λ max of organic compound using spectroscopic techniques.
- Determination equivalence conductance and dissociation constant
- Determination of mutational and optical properties of organic chemistry
- Determination of physical properties of various organic and inorganic compounds.

Laboratory Outcomes: By the end of the course student will be able to:

LO:1 apply basic theoretical knowledge of the instrumentation techniques available.

LO:2 apply practical skills for the analysis of drugs & excipients using various instrumentation techniques.

LO:3 learn documentation and express the observations with clarity.

LO:4 apply the professional and safety responsibilities for working in the analysis laboratory.

LO:5 know how to handle different instruments data for interpretation.

Course Contents: List of Practical's-

1. Verification of Beer– Lambert's Law by Colorimeter.
2. Determination of λ_max.
3. Quantitative determination of the compounds by spectrometric method.
4. Determination of composition of binary mixture containing $K_2Cr_2O_7$ and $KMnO_4$ using spectrophotometer.
5. Determination of equivalent conductivity and dissociation constant of a weak electrolyte.
6. Determination of equivalent conductance of a strong electrolyte at different dilutions and verification of Onsagar's equation.
7. Determination of hydrolysis constant of aniline hydrochloride.
8. Determination of inversion and energy of activation of the reaction for the cane sugar in presence of an acid.
9. Determination of relative strength of acids by studying the inversion of activation of the cane sugar in HCl and H_2SO_4 acids.
10. Determination of mutarotation of glucose catalysed by acid or base.
11. Determination of order of reaction for alkaline hydrolysis of ethyl acetate.

12. Determination of pH of the given solution using glass electrode including calibration of pH meter.

Assessment : Term end practical exam and comprehensive viva-voice.

Text Books:

1. Advanced practical physical chemistry, J. B. Yadav , Krishna
2. Practical Physical Chemistry, Arthur A. Vernon, Sixth edition (Findlay, Alexander)

Reference Books:

1. Advanced Practical Organic Chemistry, Third Edition John Leonard, CRC Press.
2. Vogels' Practical Organic Chemistry, Ethyl Sulfate. Uploaded by. Joan Mas Torrent. Mann.

M.Sc. Applied Chemistry
Semester-III
CH 91305: CHEMISTRY OF DRUGS (NATURAL)

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives:The basic focus of this course is consideration of structural and physiological functions of various naturally occurring molecules. Emphasis would be given on significant active compounds from natural sources such as antibiotics, steroids, hormones, etc. The course will stimulate interest of students in following areas:

- General methods of determination of structure of various alkaloids.
- Study of various antibiotics, their commercial production and biological significance.
- Role of steroids and hormones and their structural elucidation.

Course Outcomes: By the end of the course student will be able to:

CO1: recognize the different types of alkaloids, antibiotics, hormones & proteins & their chemistry & medicinal importance.

CO2: explain vitamins Chemistry and Physiological significance of Vitamin.

CO3: elaborate general methods of structural elucidation of compounds of natural origin.

CO4: illustrate isolation, purification and characterization of simple chemical constituents from the natural source.

CO5: explain protein, enzyme and nucleic acids and their Physiological significance in human physiology.

Course Contents: Theory-
Introduction, Sources, isolation , synthesis, structure determination, physiological activity and structure Activity relationship (if any) of:
Unit-I
Alkaloids
General methods of determination of structure, nicotine, atropine, cocaine, conine, morphine, papaverine, quinine, reserpine, strychnine, ephedrine.

Unit-II
Antibiotics
(a) Definition, classification and importance, general study of penicillins, cephalosporins, aminoglycosides, tetracyclines, macrolides, lincomycins, polypeptides, polyenes, griseofulvin, and vancomycin.
(b) Commercial production, constitution, properties, biological significance of penicillin, streptomycin, tetracyclines and chloramphenicol.

Unit-III
Steroids
(a) Sterols : Classification, role in biochemistry, structure elucidation with emphasis to following compounds: cholesterol, bile acids and their relation to cholesterol.
(b) Adreno: Hormones: Cortisone, Cortisol, Adrenaline.

Unit-IV

(a) Sex Hormones: Oestrogens, Androgens, Progesterone
(b) General Study of Anterior and Posterior Pituitary Hormones.

Unit-V
(a) Proteins and Enzymes
The peptide linkage, primary structure of peptides, synthesis of peptides, secondary and tertiary structure of proteins, oxytocin, insulin, biosynthesis of proteins, Nomenclature of enzymes, cofactors, mechanisms of enzyme actions, Enzyme inhibitors.
(b) Purines and Nucleic acids
Uric acid, purine derivatives and xanthine bases, nucleosides, nucleotides, RNA and DNA, chemical and enzymatic synthesis of polynucleotides.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Books & References Recommended :
Text Books:

1. Chatwal G.R. Chemistry of natural products Vol I & II (Himalaya Publishing House)
2. Agrawal O.P. Chemistry of natural products Vol I & II (Goel Publishing House)

Reference Books:

1. L. F. Fieser and sM. Fieser. Steroids. (Reinhold Publishing Corporation, New York)
2. Sewald N, Hans-Dieter Jakubke Peptides: Chemistry and Biology. (Wiley-VCH publisher).
3. Li JJ, Corey EJ, Total Synthesis of Natural Products: At the Frontiers of Organic Chemistry, (Wiley-VCH publisher).
4. Finar I.L., Organic Chemistry Vol.I and II (ELBs and Longman Ltd. New Delhi)
5. Lednicer D, Steriod chemistry at a glance (Wiley publisher).
6. Dewick P.M., Medicinal natural products (Wiley publisher).

Journals:

1. The Journal of Antibiotics
2. Pharmaceutical Chemistry Journal
3. Drug and Chemical Toxicology
4. Medicinal chemistry Journals
5. Chemistry - A European Journal

M.Sc. Applied Chemistry
Semester-III
CH 91306: CHEMISTRY OF DRUGS - II

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives:This course is an extension of the previous course on synthetic drugs. Different classes of drugs will be the focus of this course which has been not covered earlier. The course will stimulate interest of students in following areas:

- Analgesics, antipyretic, antiinflammatory drugs, sedatives and hypnotics
- Antidepressant, antianxiety agents and tranquilizers
- Drugs targeting the nervous system such as cholinergic agents and antihistamines
- Diuretics, antimalarial and cardiovascular drugs

Course Outcomes: By the end of the course student will be able to:

CO1: describe structure, mechanism of action and uses of analgesics, sedatives and hypnotics Drugs.

CO2: describe structure, mechanism of action & uses of antidepressants & antianxiety agents, Tranquilizers, & anti emetics

CO3: recall structure, mechanism of action and uses of autonomic drugs.

CO4: describe the drugs acting on Diuretics, antimalarial and cardiovascular system

CO5: explain the new updates on the Antineoplastic and respiratory drugs and describe the chemistry and use of hypoglycemic agents.

Course Contents: Theory-
Unit I
(a) Analgesics, antipyretics and antiinflammatory drugs, acetaminophen, amidopyrine, antipyrine, oxyphenabutazone, phenyl butazone, pethidine, ibuprofen, ketoprofen, mefenamic acid, fulfenamic acid, diclofenac sodium. (Alclafenac). piroxicam and nimesulide.
(b) Sedatives and hypnotics : Barbiturates, acyclic ureides, carbonal, barbital, cyclic imides and amides, benzodiazepines, glycol and its derivatives, oxazole derivatives.

Unit II
(a) Antidepressants and antianxiety agents phenyl ethylamine analogues, monoamine oxidase inhibitors, tricyclic antidepressants.
(b)Tranquilizers
Phenothiazines; benzoquinolizines.
(c) Anticonvulsants
Hydantoins, oxazolidine-diones, succinimides, primidone, phenacemide.
(d) Antiemetics
Trimethobenzamide, diphenidol.

Unit III
Autonomic drugs
(a) Cholinergic agents

Methacholine chloride,carbachol, Edrophonium chloride, physostigmine, neostigmine, pyridostigmine.
(b) Anticholinergic agents
Dicyclomine, oxyphenonium bromide, isopropamide iodide, diphenhydramine.
(c)Adrenergic agents
Epinephrine and related compounds, ephedrine and related compounds, imidazoline derivatives.
(d) Antihistamines
Ethanolamine derivatives, ethylene diamines, alkylamines, phenothiazines and piperazines.

Unit IV
(a) Diuretics
Sulphonamides, thiazides, sulphamyl benzoic acid derivatives.
(b) Antimalarials
4-amino quinolines, 8-amino-quinolines, 9-amino-acridines, biguanides, pyrimidines and sulphones.
(c) Cardiovascular drugs
Antianginals and vasodilators. Antiarrythmic drugs. Antihypertensive drugs, antihyperlipidemic agents, anticoagulants and antiplatelet drugs, sclerosing agents.

Unit V
(a) Hypoglycaemic agents
Sulphonyl ureas and biguanides.
(b) Antineoplastic drugs
Alkylating agents, antimetabolites, antineoplastic antibiotics.
(c) Respiratory drugs
Respiratory stimulants, antitussives, expectorants, mucolytics and decongestants antiasthmatics.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Books & **References Recommended :**
Text Books:

1. Ashutosh Kar Medicinal Chemistry (New Age International Ltd. New Delhi)
2. Wilson & Gisvold, Organic Medicinal and Pharmaceutical Chem & stry. (Lippincott International Edition)

Reference Books:

1. May's, Chemistry of Synthetic Drugs. (UNODC Publications)
2. William Foye, Principles of Medicinal Chemistry. (Varghese & Co.)
3. Berger J, Medicinal Chemistry.(John Willy & sons).
4. Chatwal G.R., Chemistry of natural products Vol I & II Chemistry of Synthetic Drugs. (Himalaya Publishing House).
5. Lednicer D. & Lester A. Mitscher Organic Chemistry of Drug Synthesis., (John Willy & sons).
6. Satoskar R.S. Medicinal Chemistry(India Popular Prakashan).

Journals:

1. Journal of Cardiovascular Disease Research
2. Journal of Malaria Research

3. Pharmacology of Antihistamines

4. International Journal of Impotence Research

5. Antidepressants: MedlinePlus

M.Sc. Applied Chemistry
Semester-III
CH 91307: COMPUTER APPLICATIONS IN CHEMISTRY

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives:In this course students will be introduced basic computer skills and programming languages. At the end of this course students should be well versed in following topics:

- Introduction to computers, networking and database management.
- Basic computer language C, python and Fortran
- Use of softwares and programming techniques in chemistry

Course Outcomes: By the end of the course student will be able to:

CO1: recall & infer the fundamentals of Computer, its components, structure, types & Peripheral devices.

CO2: identify and apply the knowledge of networking and database management system.

CO3: identify and apply the knowledge of languages like C, Python/FORTRAN.

CO4: apply and write the computer code in chemistry

CO5: identify and apply the software packages in chemistry.

Course Contents: Theory-
UNIT I
Computers and peripheral devices
(a) Review of basic concepts of computers and peripheral devices.
(b) Basic organization of digital computers.
(c) Introduction of Operating systems.
(d) Computer languages
(e) Introduction to Internet.

UNIT II
Computer programming using C, Python/FORTRAN
(a) Principle of programming, algorithms and flow-charts.
(b) Basic concepts of FORTRAN/C/Python, Subroutines, loops, control statements, transfer statements.

UNIT III
Networking and Data Base System:
(a) Networking :Historical background, Need & Advantage of computer network, Type of computer network, LAN, MAN, WAN, Basic HW & SW requirement for networking
(b) Introduction to Database, Database application in chemistry, Characteristics of DBMS, Protein data bank, PubChem database.

UNIT IV
Programming in chemistry:
Development of small computer codes involving simple formulae in chemistry, such as van der Walls equation pH titration, Kinetics, radioactive decay, evaluation of lattice energy and ionic radii from experimental data.

UNIT V
Software package in Chemistry
(a)Linear and Non-linear Regressions.
(b)Introduction to Structure drawing and chemical calculation software packages

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weight-age is 70%.

Books & References Recommended :
Text Books:

1. R Kumari Computers & their Applications to Chemistry (Prentice- hall, New Delhi)
2. K.V Raman Computers in Chemistry (Tata Mcgraw Hills)

Reference Books:

1. V Rajaraman , Fundamentals of Computers.(Prentice- hall, New Delhi)
2. FORTRAN Mannuals

Journals:

1. Journal of Computer-Aided Molecular Design
2. Journal of Cheminformatics
3. Chemical Biology & Drug Design
4. Current Computer-Aided Drug Design
5. Computer-Aided Design

M.Sc. Applied Chemistry
Semester-III
CH-91308:ADVANCED ORGANIC AND MEDICINAL CHEMISTRY

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	4	-	-	30	70	-	-	100

Pre-requisite: Nil
Course Objectives:This course covers some advanced aspects of organic chemistry such as conformation and stereo chemistry of molecules and their applications in medicine. On successful completion of the course, students will be able to:

- Demonstrate the importance of chemistry in the development and application of therapeutic drugs.
- Obtain knowledge of various name reactions and green synthesis of drugs.
- Understand the processes employed in pharmaceutical industries.

Course Outcomes: By the end of the course student will be able to:

CO1: learn the structural activity relationship of the important class of drugs.

CO2: design new techniques of organic synthesis using green chemistry.

CO3: apply various processes involved in pharmaceutical manufacturing process.

CO4: identify stereogenic centres in organic molecules and appreciate the role of chirality in nature and in drug design.

CO5: learn various structure based drug design methods.

Course Contents: Theory-
UNIT I
Advanced Stereochemistry and its applications
Role of stereochemistry in Pharmacokinetics and Pharmacodynamics.Selective organic transformations –chemoselectivity, regioselectivity, stereoselectivity, racemic switches, dynamic stereochemistry , stereoselective synthesis, uses of chiral homogenous and heterogeneous catalysts.

UNIT II
Drug design and Chiral techniques in synthesis of drugs
Concepts of pro drugs and soft drugs, Principles of drug parameters. Designing of new drugs using green chemicals.
Concept of chiral drugs, asymmetric synthesis of following drugs:-Vitamin C, Atenolol, Nifedipine, Ethambutol, Omeprazole, Aspertame, Ampicillin and Thalidomide.

UNIT III
Mechanisms, stereochemistry and applications of following reactions of synthetic importanceBirch reduction, Mannich reaction, Diel's alder reaction, Meerwein Ponndorf verley reduction, Oppeneaur oxidation, Catalytic hydrogenation reactions, Ozonolysis, Reformatsky reaction, Michael reaction.

UNIT IV
Eco-friendly Techniques in organic synthesis
Water as solvent, ionic liquids, supercritical liquids, supported reagents and catalysts, solvent free reactions, microwave & ultrasound assisted synthesis, biocatalytic synthesis.

UNIT V
Unit processes
Introduction, types of reagents, methods, mechanism, controlling factors and applications of following: Nitration, sulphonation, halogenation, oxidation and reduction. Introduction to Drug and Pharmaceutical Industries: varoius divisions and their working.

ASSESSMENT:

- Continuous evaluation through two/three mid-term test with a weight-age of 30 % of the total marks. It includes class attendance as well as assignments on the course topics.
- The end-term theory examination weightage is 70%.

Books & References Recommended:
Text books:

1. Finar I.L., Organic Chemistry Vol.I and II. (ELBs and Longman Ltd. New Delhi).
2. Jerry March, Structure Reactions and Mechanism (John Willy & sons).

Reference books:

1. Organic Chemistry of Drug Synthesis Lednicer D. & Lester A. Mitscher, (John Willy & sons).
2. Groggins, P. H., Unit processes in organic synthesis (McGraw Hill publication).
3. Eliel E.L., Stereochemistry of Carbon Compounds (John Willy & sons).
4. Kalsi P.S., Stereochemistry of Organic Compounds (New age International).
5. Srivastava M.M., Green Chemistry (Narosa publication).
6. May's, Chemistry of Synthetic Drugs (UNODC Publications).

Journals:

1. Chirality
2. Tetrahedron: Asymmetry - Journal - Elsevier
3. Journal of Chemical Education –ACS
4. Journal Of Environmentally Friendly Processes
5. Journal of Green Science and Technology

M.Sc. Applied Chemistry
Semester-III
CH 91389: COMPUTER LAB

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
-	8	-	-	4	-	-	-	40	60	100

Pre-requisite: Nil
Course Objectives: Through these practicals, students will be introduced to basic computer skills and programming languages. At the end of this course, students would have learned

- Networking and database management
- Basic computer languages- C, Python and Fortran
- Use of software's and programming techniques in chemistry

Laboratory Outcomes: By the end of the course student will be able to:

LO1: apply diversified solutions using FORTRAN/C++/PYTHON language

LO2: construct the program in FORTRAN/C++/PYTHON language

LO3: apply software packages for various operations in chemistry

LO4: use the online and offline tools for solving chemistry related problems.

LO5: interpret chemical structure databases of a chemical compound

Course Contents: List of Practical's-

1. Programming in FORTRAN/C++/PYTHON
   Write codes for:
   (a) First Order Kinetics Equation
   (b) Second Order Kinetics Equation
   (c) van der Waals Equation
   (d) Linear Regression equation
      i. Equation for Slope
      ii. Equation for intercept
      iii. Equation for R and R2
   (e) Solving two dimensional arrays
   (f) Half life period
2. Use of Chemistry software packages such as ChemSketch, ChemDraw etc for:
   (a) Structure drawing
   (b) Geometry Optimization
   (c) Estimation of various physic-chemical properties.
3. Use of Online Chemical structure databases for extraction of information for a chemical compound
4. Use of Online Chemistry Software for their applications in solving chemistry problems.

5. Use of Office tools for writing reports, performing mathematical manipulations, plotting of graphs, preparing presentations.

Assessment : Term end practical exam and comprehensive viva-voice.

Text Books Recommended:

1. R Kumari Computers and their Applications to Chemistry (Prentice- Hall, New Delhi)
2. K.V Raman Computers in Chemistry (Tata McGraw Hills)

Reference Books:

1. V Rajaraman, Fundamentals of Computers.(Prentice- hall, New Delhi)
2. FORTRAN Manuals
3. Harsh Bhasin,Python for Beginners(New age international, New Delhi).

M.Sc. Applied Chemistry
Semester-IV
CH 91499: DISSERTATION

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
-	-	44	-	26	-	-	-	120	180	300

B.Tech. I Year Chemistry
Semester- A & B
CH10516: CHEMISTRY

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
4	-	-	3	-	-	30	70	-	-	100

Program Outcomes (POs):

POs describe what students should know and be able to do at the end of the programme. POs are to be in line with the graduate attributes as specified in the Washington Accord. POs are to be specific, measurable and achievable. NBA has defined 12 POs.

Graduates will be able to achieve:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs): For Theory Course

Course outcomes are the statements of what a student should know, understand and/or be able to demonstrate after completion of a course.
The course will enable student to:

CO1 Describe the basics of Organic, Inorganic and Physical Chemistry.

CO2 Apply Specifications, testing and treatment of water for industrial and domestic use.

CO3 Illustrate Concepts, manufacturing and applications of different types of industrially important materials and their maintenance.

CO4 Explain the applications of spectral and analytical techniques in qualitative and quantitative analyses.

CO5 Understand the Ethics behind applying Chemical Methods in Industries and day-to-day use.

Pre-requisite: Knowledge of basics of Chemistry studied in Class XI and XII.

Course Objectives: This course aims at imparting knowledge of the subject to the students for making them understand the role of chemistry in the field of engineering. The focus is on developing capabilities of students to use various analytical techniques, their applications in characterization of various materials used in different fields of engineering.

Course Outcomes: The course will enable student to understand:

- Basics of Organic, Inorganic and Physical Chemistry.
- Specifications, testing and treatment of water for industrial and domestic use.
- Concepts, manufacturing and applications of different types of industrially important materials and their maintenance.
- Applications of spectral and analytical techniques in qualitative and quantitative analyses.
- The students will understand the Ethics behind applying Chemical Methods in Industries and day-to-day use.

UNIT I

Basics of Chemistry:

Organic Chemistry: Concept of Hybridization, Configuration (including R/S and E/Z nomenclature of isomers) and Conformation (Newman and Sawhorse Projection Formulae, with nomenclature)

Physical Chemistry: Rate Law, Molecularity and Order of Reaction, First Order Kinetics

Inorganic Chemistry: Theories of Chemical Bonding (VBT and MOT)

Green Chemistry: An overview

UNIT II

Water:

Source, Types of impurities and their effects, Hardness, its expression and determination, Boiler troubles and their causes, Analyses and treatment of water for industrial and domestic purposes, Alkalinity and its determination, IS Specifications for Water, Methods for disposal of waste water.

UNIT III

(a)Lubricants

Types of lubricants and principles of lubrications, properties (test) of lubricants, greases, graphite, cooling liquids and cutting fluids and their applications., Ethics code and Ethics management in the oil and lubricant industries.

(b) Corrosion

Principle of corrosion, types of corrosion, factors affecting (FOUR) and methods of protection (FOUR: Proper designing, use of inhibitors, use of pure metal, use of alloys). Ethics for corrosion prevention.

UNIT IV

Materials Chemistry

(a) Polymers and Polymerization

Introduction, Classification, Types, mechanism, methods of polymerization. Structure-property Relationships, compounding, general applications of polymer materials of industrial importance (Nylon66, Kevlar, PVC, Polytetrafluoroethylene (PTFE) or Teflon, Polystyrene). Concept of Biodegradable polymers, Environmental regulations for polymer based packaging materials.

(b) Nanomaterials

Introduction, synthesis, properties, nano-structured materials and their applications. Introduction to Smart materials and their applications.

UNIT V

Spectroscopic Techniques and Applications

Introduction to Spectroscopy, Principal, Instrumentation and Applications of UV and IR. Introduction to Chromatographic Techniques (Column), Use of non destructive method.

Assessment (Theory): Attendance, class test, class assignments and end semester theory exam

Books & References Recommended:

Text Books

1. Palanna O.G, Engineering Chemistry(Mc Graw Hill)
2. Dara S.S.,Engineering Chemistry (S. Chand publishing)
3. Stereochemistry: Conformation and Mechanism by PS Kalsi, New Age International Publisher
4. PC Jain and M Jain, Engineering Chemistry, 15th Edition, Dhanpat Rai publishing Co.
5. Chemistry in Engineering and Technology, JC Kuriacose and J Rajaram, Vol-I & II, Tata Mcgrow Hill Education Pvt. Limited.

Reference Books

1. D. Braun, Polymer Synthesis: Theory and Practice: Fundamentals, Methods, Experiments (Springer).
2. Ambasta B.K., Chemistry for Engineers(University Science Press)

B.Tech. I Year Chemistry
Semester- A & B
CH10652: CHEMISTRY Laboratory

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
-	2	-	-	1	-	-	-	20	30	50

List of Experiments for B.Tech. I year, Chemistry

Course Outcomes (COs): For Laboratory Course:
This laboratory course will illustrate the principles of chemistry relevant to the study of science and engineering. The students will learn to:

CO1 Develop abilities to perform various types of qualitative and quantitative analyses .

CO2 Determine properties of lubricants and oil samples.

CO3 Analyse water samples for in terms of hardness, chloride content, alkalinity and other dissolved/undissolved impurities.

CO4 Ability to understand, explain and use instrumental techniques for elucidating properties of lubricants oil samples ,chemical materials etc.

CO5 Follow to good laboratory practices during performance.

Group A

1. Determination of the viscosity of lubrication oil by Redwood Visco-meter no.1 (at five different temperatures)
2. Determination of flash point of given oil by Abel's apparatus
3. Determination of percentage of moisture in a coal sample
4. Determination of Steam Emulsification number (SEN) of a given lubricating oil sample
5. Determination of Total Solids in a water sample
6. Determination of flash point of given oil by Pensky Martin's apparatus
7. Determination of the viscosity of lubrication oil by Redwood Viscometer no.2 (at five different temperatures)
8. Determination of Aniline Point of a given oil sample
9. Determination of Drop Point of a given semi-solid lubricant
10. Determination of acid value of an oil sample
11. To study the chemical oscillations (Iodine Clock reaction)
12. Potentiometric estimation of Ferrous Ammonium Sulphate using standard Potassium Dichromate Solution
13. Determination of the partition coefficient of a substance between two immiscible liquids.

14. Synthesis of polymer and nanomaterials
15. Verification of Beer-Lambert's law by visible spectroscopy

Group B

1. Determination of hardness of water sample by EDTA method
2. Determination of carbonates, bicarbonates and total alkalinity of a water sample
3. Determination of percentage purity of iron alloy by internal indicator method
4. Determination of percentage purity of iron alloy by external indicator method
5. Determination of chloride content of water

Text Book

1. A Textbook of Quantitative Inorganic Analysis. AI Vogel, 3rd Edition, Longmans, London.
2. A Textbook On Experiments And Calculations In Engineering Chemistry, SS Dara, S. Chand Publisher

Reference book

1. Vogel's Text Book of Quantitative Analysis, Ed. GH Jeffery, J Bassett, J. Mendham and RC Denny, Longmans, London

CO PO Attainment Sheet for BTech First Year Chemistry Theory (CH10516)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3/2	3/2	-	2	1/-	2	2	2	2	2	2	2
CO2	2	2	1/-	2	1/-	3	3	3	3	3	3	3
CO3	2	2	1/-	1/-	-	3	3	3	3	3	3	3
CO4	2	3	1/-	2	-	3	3	3	3	3	3	3
CO5	1/-	1/-	1/-	1/-	1/-	3	3	3	3	3	3	3
Average	-	-	-	-	-	-	-	-	-	-	-	-

Table 1: CO PO Attainment Sheet for Dept. of Chemistry