

M.Sc. Degree Pharmaceutical Chemistry Programme

Aim and Objective of the Syllabi

Outcome

The curriculum provides valuable knowledge of various subjects like biochemistry, medicinal chemistry, pharmacognosy, pharmacology etc. A candidate can pursue a Master's Degree in Pharmaceutical Chemistry which offers various specializations like biochemistry, medicinal chemistry, pharmacognosy, pharmacology etc. After obtaining the Master's Degree and then for further research work can go for it.

Aim

Chemistry is a central subject of science. It is also closely related to daily life. The Master's program not only offers the option of focusing on a specialist area but students will also acquire the necessary skills for this and they will learn to think independently and act responsibly. Graduates will become familiar with the terminologies and special aspects of chemistry, its strengths and limitations and will be able to apply their knowledge to new issues and situations, even in an interdisciplinary context. They will gain knowledge and practical skills relating to the current state of research in selected fields. They will be able to analyze chemical issues and assess them critically, to develop independent solution strategies and to estimate their impacts in a wider context. The broad spectrum of the academic program will ensure that students acquire the skills necessary for demanding fields of activity in industry, economy and administration

Objective

The Master's course in chemistry is designed with an objective to teach post graduates with the skills to critically assess and deal with issues requiring the utilization of chemical principles from each sub-disciplines such as organic, inorganic, physical, analytical and biochemistry. It is the objective of the chemistry program to teach students the necessary knowledge in a way that enables them to familiarize themselves quickly with new developments, to be introduced to new areas and to make independent contributions to further developments of research and technology in their specialized area once they have finished their program.

Semester 1

PG1PHA C01 Inorganic Chemistry - I

Aim and Objectives

This is a chemistry module designed for chemistry majors and features the principles of coordination chemistry, boron compounds and that of nuclear chemistry. In depth discussion about coordination compounds focusing primarily on their structure and various aspects of bonding will be done. The course covers synthesis, structure and bonding of organometallic compounds. Kinetics of reactions of metal complexes and their mechanism will also be illustrated. The learners should be able to apply these topics in various fields.

- To mould the chemistry majors in coordination chemistry, boron compounds and nuclear chemistry
- To understand the structure and various aspects of bonding in the coordination compounds
- To achieve knowledge about the synthesis, structure and bonding of organometallic compounds
- To illustrate the kinetics of reactions and their mechanism of metal complexes
- To acquire ability to apply the theoretical knowledge in various fields

PG1 PHA C02 Organic Chemistry - I

Aim and Objectives

The module deals primarily with the basic principles to understand the structure and reactivity of organic molecules. Emphasis is on substitution and elimination reactions of aliphatic and aromatic compounds. Learners will get the essential ideas on how simple molecules can be constructed. Bonding in conjugated systems, reactions mechanism, organic transformations and stereochemistry will likewise be discussed.

- To understand the structure and reactivity of organic molecules
- To emphasize the substitution and elimination reactions of aliphatic and aromatic compounds
- To get an idea about the construction of simple organic molecules
- To impart knowledge about stereochemistry of organic compounds and basic principles of conformational analysis
- To know the bonding in conjugated systems and various reaction mechanisms

PG1 PHA C03 Theoretical Chemistry - I

Aim and Objectives

This module looks at quantum chemistry and group theory. A more profound comprehension of quantum chemistry beginning from its postulates and basic systems such as particle-in-a-box to hydrogen like atoms is explored. The second part of the module looks at molecular symmetry and applications in molecular orbitals analysis and vibrational spectroscopy, electronic transitions of carbonyl chromophore and origin of selection rule of electronic transition. Learners will be able to apply these ideas to individual atoms and molecular systems.

- To get a comprehensive idea about quantum chemistry and group theory
- To discuss the emergence of classical mechanics over quantum mechanics
- To get an awareness about the basic postulates of quantum chemistry and its application to hydrogen and hydrogen like atoms
- To acquire knowledge for deriving the wave function, energy, momentum etc. of a particle under different conditions of motions
- To impart knowledge about the molecular symmetry and its applications in molecular orbitals analysis
- To gain information about various spectroscopic techniques, their selection rules and applications based on group theory.
- To solve the problems based on the theories

PG1 PHA C04 Physical Chemistry - I

Aims and Objectives

Physical chemistry is the study of phenomena in chemical systems in terms of physical concepts and laws. In this module, different branches of thermodynamics will be explored. In *Classical Thermodynamics* kinetic theory of gases, and the energetics of chemical reactions will be explored. Thermodynamics of natural processes and energy transformations in living organisms will be discussed in *Irreversible thermodynamics*. *Statistical Thermodynamics* looks at the relationship between molecular and bulk properties of matter, including examples such as the use of partition functions in equilibrium, transition states and heat capacity of chemical systems. Learners will be familiarized with the behavior of matter in bulk.

- To the study of phenomena in chemical systems in terms of physical concepts and laws

- To analyze different branches of thermodynamics like *Classical Thermodynamics*, *Irreversible thermodynamics* and *Statistical Thermodynamics*
- To explore the kinetic theory of gases and the energetics of chemical reactions
- To discuss thermodynamics of natural processes and energy transformations in living organisms
- To correlate the molecular and bulk properties of matter, including partition functions in equilibrium, transition states and heat capacity of chemical systems
- To familiarise the behaviour of matter in bulk
- To solve the problems based on the theories

Semester 2

PG2 PHA C05 Inorganic Chemistry - II

Aim and Objectives

This module covers three parts: non-aqueous solvents, bioinorganic chemistry and organometallic chemistry. Part 1 deals with acid-base concept and reactions in non-aqueous solvents. Part 2 describes basic principles and concepts of bioinorganic chemistry including the mechanisms of reactions catalyzed by metalloproteins, and kinetics of electron transfer in proteins. Part 3 focuses on the spectral and magnetic properties of transition metal complexes. A comprehensive discussion on inorganic cages and metal clusters follows. The learners will understand the different modes of reactions of organometallic compounds and their applications can be explored.

- To understand the basic concepts and principles of bioinorganic chemistry
- To familiarise the mechanisms and kinetics of different reactions catalysed by metalloenzymes
- To explore the electronic spectra and magnetic properties of transition metal complexes
- To study the stereochemistry of coordination compounds
- To understand the different reactions and catalysis of organometallic compounds

PG2 PHA C06 Organic Chemistry - II

Aim and Objectives

This module covers the study of a selected series of organic reactions involving reactive intermediates and/or molecular rearrangements. Emphasis is placed on an understanding of their reaction mechanisms. These will include reactions involving carbocations, carbanions, carbenes, carbenoids, nitrenes and arynes as intermediates. Reactions initiated by radicals will be covered. Comprehensive discussions on organic photochemistry including the rules and stereochemical consequences in pericyclic reactions will be given. The learners should be able to apply these ideas in the field of organic synthesis.

- To understand the basic concepts of selected series of organic reactions involving reactive intermediates and/or molecular rearrangements
- To acquire knowledge about name reactions involving radical intermediates
- To understand the symmetry properties of molecular orbitals of selected compounds
- To develop idea about pericyclic reactions
- To understand the basic principles of photochemistry and to apply these principles in different photochemical reactions

PG2 PHA C07 Theoretical Chemistry - II

Aims and Objectives

The objective of this model is to familiarize the learner with the approximation methods of quantum mechanics and its applications to the various theories of chemical bonding. Molecular structure evaluation

using group theory will enable the learners to apply it in the field of spectroscopy. To apply the concept of molecular modelling to isolated molecular systems.

- To get idea about various approximation methods to solve many electron systems other than simple systems.
- To discuss the applications of variation method and perturbation method for He atom
- To get an awareness about the SCF, HFSCF methods etc.
- To acquire ability to solve Schrödinger equations for molecules.
- To familiarize with the approximation methods of quantum mechanics and its applications to the various theories of chemical bonding.
- To acquire ability to apply MO treatment to homo and heteronuclear molecules
- To impart knowledge about the HMO theory and its applications to various molecules
- To evaluate molecular structure by using group theory
- To gain information about computational chemistry as a tool and find its applications
- To familiarize different molecular mechanics methods and to understand different force fields
- To achieve knowledge about different methods like HF, Ab initio, molecular mechanics semiempirical, DFT etc.
- To acquire ability to write the Z matrix of different type of molecules
- To familiarize about GAMESS/Firefly and its applications
- To solve the problems based on the theories

PG2 PHA C08 Physical Chemistry - II

Aims and Objectives

In this module, the basic idea of how light interacts with matter, in particular atoms and molecules will be conferred. Microwave, infrared, Raman, electronic and nuclear magnetic resonance spectroscopic techniques will be discussed. Students will be able to apply these principles in the area of molecular spectroscopy.

- To understand the origin of different spectra and characterise the regions of the electromagnetic spectrum.
- To familiarise the microwave spectroscopy and its applications
- To identify Morse potential energy diagram and different types of bands and different types of vibrations and the application of IR spectroscopy
- To get aware about FT spectroscopy and FTIR
- To characterize term symbols and electronic spectra of different molecules
- To identify different types of lasers and realise its applications
- To understand the Mossbauer spectroscopy by learning the principle and recording of spectrum including Doppler effect, chemical shift etc.
- To familiarise the Raman spectroscopy and its applications
- To interpret the complementarities of Raman and IR spectra
- To understand the basic principles of NMR spectroscopy
- To familiarise the second order effects on spectra
- To understand NOE effect, two dimensional NMR, COSY and HETCOR, ^{13}C NMR,
- To familiarise EPR and NQR spectroscopy

PG2 PHA P01 Inorganic Chemistry Practical - I

Aim and Objectives

This is a module intended for chemistry majors. It deals with qualitative and quantitative inorganic analysis along with preparation and characterization of inorganic complexes. The learners will have the option to apply these ideas in various fields pertaining to inorganic chemistry.

- To familiarise different metal salts including rare earths
- To analyse quantitatively different ions using colorimetry
- To characterize the synthesised inorganic complexes

PG2 PHA P02 Organic Chemistry Practical - I

Aim and Objectives

In this module, students will learn to apply various techniques to separate a mixture into its individual components and identify each component. Guided under the general principles of analytical and physical chemistry, these techniques include solvent extraction, TLC and column chromatography. Students will also acquire the skill to use the computational tools to draw the reaction schemes and mechanisms of various organic reactions.

- To develop skill in separating different organic mixtures and analyse it
- To familiarise various separation techniques such as solvent extraction, TLC and column chromatography
- To acquire skill to draw structure of organic compounds and the reaction schemes and mechanism of organic reactions using Chems sketch

PG2 PHA P03 Physical Chemistry Practical - I

Aims and Objectives

In this module, students will learn about the practical applications of various principles of physical chemistry like phase rule, adsorption, and surface tension. Learners will be able to use computational software to predict the geometry of a molecule, calculate its energy levels, assess the HOMO and LUMO energy, and predict its spectral behavior.

- To familiarise different isotherms and to determine the concentration of the given acid using the isotherms
- To construct the phase diagrams of simple eutectics and three component systems
- To acquire knowledge about the effect of salts on miscibility temperature
- To calculate distribution coefficient and equilibrium constant based on distribution law
- To determine the surface tension of a liquid by various methods
- To acquire knowledge about computational software like GAMESS/Firefly
- To predict the geometry of a molecule, calculate its energy levels, assess the HOMO and LUMO energy by using GAMESS/Firefly.

Semester 3

PG3PHA C09 Organic Chemistry- III (Synthetic and Bioorganic Chemistry)

Aims and Objectives

- To enable the students to acquire proper knowledge about various methods of oxidation and reduction reagents. Students will learn about synthetically useful transformations including oxidations and reductions reactions. The emphasis will be on developing a mechanistic understanding of selectivity and synthetic strategy.

- Enable to use various reagents and organic reactions in a logical manner in organic synthesis. An ability to apply synthetic reagents like, DDQ, NBS, DCC, Gilman reagent etc in organic synthesis and to get insights into novel reactions and reagents in organic synthesis.
- To study the important stereoselective transformations in organic synthesis like Asymmetric induction, Enantioselective catalytic hydrogenation, Asymmetric aldol condensation, Asymmetric Diels-Alder reactions and Asymmetric epoxidation.
- The students will be able to understand different approaches toward the synthesis of carbocyclic and heterocyclic ring formation etc.
- To impart the students in depth knowledge about the heterocyclic compounds for different elements containing heterocyclic ring and to develop quantitative ideas about the synthesis, properties and uses of such heterocyclic compounds like thiazole, oxazole, pyrimidines, purines, quinoline and isoquinoline.
- To impart the students in depth knowledge about name reactions in cyclisation and construction of macrocyclic rings-ring closing metathesis.
- To get a brief idea and appreciation of the significance and application of supramolecular chemistry and its applications in organic chemistry, chemical biology, medical and perfumery industries. Based on the analysis of a series of host molecules, students able to identify and hypothesize the trends in reactivity and binding of guests.
- To impart the students thorough idea in the chemistry of terpenoids, steroids, alkaloids and vitamins, proteins and nucleic acids.
- To study the fundamentals of natural colouring species and basic principles of the biosynthesis of terpenes, carbohydrates, proteins and nucleic acids.

PG3 PHAC10 Physical Chemistry- III (Advanced Topics in Physical Chemistry)

Objectives:

- The objective is to study the basics of electrochemistry and its importance to modern industry and technology.
- To give an in-depth account of different theories of reaction rates, kinetics of fast reactions and reaction in solution.
- To study the chemistry of surfaces and various techniques employed for the characterization of different types of surface phenomena and the importance of adsorption process and catalytic activity at the solid surfaces.
- To recognize the general properties of colloids and macromolecules.
- To study the different types of quantum statistics and its comparison, Laws related to heat capacity of solids, phase transition and thermionic emission.
- To acquire knowledge of photochemistry and photophysical principles, their applications

Outcome:

- Understand theories of ions in solutions.
- Apply the theories to explain the variation of ionic conductance with concentration, electric field.
- The student will acquire knowledge about different theories on reaction rate, can analyse the mechanistic path and the experimental conditions of different types of reactions.

- Will able to understand the different techniques for analysing fast reactions.
- Will appreciate the applications of chemical principles of surface catalysis and colloidal chemistry in industrial synthesis.
- Able to classify colloids present in nature apply its properties in daily life.
- Apply the principles of adsorption in daily life situations.
- The student will able to apply photochemistry and photophysical principles on environmental and biological processes and will explain photophysical energy conversion to generate electricity
- Gains numerical ability and analysing power to solve problems.

PG3PHA C11 Medicinal Chemistry I (Drug Design and Pharmacology)

Aim: This course is designed to impart a fundamental knowledge on the preparatory pharmaceutical chemistry of preparing the different conventional dosage forms. The main purpose of the area pharmacology is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

Objectives: Upon completion of this session the student should be able to

- Understand the pharmacological actions of different categories of drugs
- This subject deals with the monographs of inorganic drugs and pharmaceuticals.
- understand the medicinal and pharmaceutical importance of inorganic compounds
- Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations.
- Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
- Understand the professional way of handling the prescription
- Preparation of various conventional dosage forms

PG3 PHA C12 Spectroscopic Methods in Chemistry

Course Objectives:

- To understand the basic ideas of different spectroscopic Techniques
- To identify the compounds by analyzing the UV, IR NMR and Mass spectrum
- To interpret the spectrum of organic compounds
- To develop the structure elucidation skill of organic compounds using different types of spectral data

Outcome:

- Achieve advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
- To understand the selection rules of UV-Visible spectroscopy and learn the various rules to calculate the absorption maxima.
- Study the chiroptical properties and do the problems
- be able to analyse and interpret IR spectroscopic data based on stereochemistry and various factors influencing the spectra study the basic principles of NMR and factors influencing spectra and understand the advanced topics like two dimensional spectroscopy.

- Study mass spectroscopic techniques and problems based on it.
- Be able to solve problems related to the structure and to study molecular interactions by choosing suitable spectroscopic methods and interpreting corresponding data.

PG4PHA E01 Bacteriology and Biochemistry

Aim: This subject is designed to impart fundamental knowledge on the various microorganisms and general principles of microbial control, immunity, structure and chemistry of amino acids, proteins and nucleic acids enzymes and hormones. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. The subject emphasizes on biological oxidation and electron transport chains. The syllabus also emphasizes on the study of composition of blood cells and regulation of acid base balance.

Objectives: Upon completion of this session student shall be able to

- Understand the various microorganisms, their growth requirements, staining techniques and general principles of microbial control.
- Understand the various types of immunity, antigen - antibodies reactions and various types of vaccines.
- Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
- Understand the role of hormones.
- Understand the metabolism of nutrient molecules in physiological and pathological conditions.
- Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.
- Understand the biological oxidation and electron transport chains.
- Understand the Blood groups and the composition blood cells.
- Understand the Blood clotting- factors and mechanism.
- Understand the Regulation of acid base balance
- To understand the importance of metabolism of substrates.
- Will acquire chemistry and biological importance of biological macromolecules.
- To acquire knowledge in qualitative and quantitative estimation of the biological macromolecules.
- To know the interpretation of data emanating from a Clinical Test Lab.
- To know how physiological conditions influence the structures and re-activities of biomolecules.
- To understand the basic principles of protein and polysaccharide structure. Students will be able to acquire, articulate, retain and apply specialized language and knowledge relevant to microbiology.

PG4PHA E02 PHARMACOGNOSY & PHARMACEUTICAL OPERATIONS

Aims and Objectives

- In this module, students will learn about the Pharmacognosy of official drugs used in pharmacy. various principles of dispensing medicaments
- Identify drug from natural origin and their supply, cultivation, collection, storage along with their aspecial conditions

PG4 PHA E03 Medicinal Chemistry II

Aim: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the session the student shall be able to

- understand the chemistry of drugs with respect to their pharmacological activity
- understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
- know the Structural Activity Relationship (SAR) of different class of drugs
- write the chemical synthesis of some drugs

Course Content

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs.

PG4PHA E01 Elective 1 Bacteriology and Biochemistry

Aim: Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions.

Objectives: Upon completion of this session student shall be able to

- Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
- Understand the metabolism of nutrient molecules in physiological and pathological conditions.
- Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.
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PG4PHA P04 PHARMACEUTICAL ANALYSIS PRACTICAL

Aim: This practical session deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

Objectives: Upon completion the student shall be able to

- understand the principles of volumetric and electro chemical analysis
- carryout various volumetric and electrochemical titrations
- develop analytical skills

PG4PHA P05 DRUG SYNTHESIS AND DISPENSING PRACTICAL

Course outcomes:

1. To synthesise of drugs and drug intermediate through multi-step organic syntheses.
2. To perform the organic synthesis using green alternatives of the conventional chemical methods.
3. To synthesise organic compound using microwave assisted organic syntheses.
4. To analyse and predict the FTIR, ^1H and ^{13}C NMR spectra of the intermediates and products at each stage of synthesis by the above methods.
5. To carry out the dispensing of emulsions, liniments and mixtures involving incompatibilities.

PG4PHAP06 BIOCHEMISTRY AND BACTERIOLOGY PRACTICAL

Aim: This practical session deals with the fundamentals of analytical chemistry for the analysis of blood, urine, milk and water and isolation techniques of phytochemicals from their natural sources. This practical session also deals with the preparation of some typical nutrient media for collection and isolation of Bacteria and different Staining techniques for the study of the morphology of the bacteria. .

Objectives: Upon completion the student shall be able to

- Understand the principles of determination of blood group and Rh factor.
- Understand to enumerate RBC, WBC and DC of blood.
- Understand to estimate qualitatively and quantitatively the different components present in the blood, urine, milk and water
- Understand to isolate different phytochemicals from their natural sources.
- Understand to separate mixtures of serum proteins, amino acids and dyes by different techniques.
- Understand to prepare some typical nutrient media for collection and isolation of bacteria.
- Understand the different staining methods for the study of the morphology of the bacteria.
- Understand the method of study of antibacterial activity of compounds and complexes.
- Students will acquire and demonstrate competency in laboratory safety and in routine and specialized microbiological laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.

- Students will communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.
 - Students will demonstrate isolation of and identification of microbes.
 - Students can able to design microbiology laboratory considering all the aspects of safety
 - Students will acquire knowledge about validating the microbiological equipment and reporting the observations
 - To understand the importance of metabolism of substrates.
 - Will acquire chemistry and biological importance of biological macromolecules.
 - To acquire knowledge in qualitative and quantitative estimation of the biological macromolecules.
 - To know the interpretation of data emanating from a Clinical Test Lab.
 - To know how physiological conditions influence the structures and reactivity's of biomolecules.
 - To understand the basic principles of protein and polysaccharide structure.
 - Develop analytical skills
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