

**M.SC. PHARMACEUTICAL CHEMISTRY PROGRAMME**

**CREDIT MATRIX**

Course code	Course name	Credits				Marks										Remark
		L	T	P	Total	C1			C2			C3			Total	
						L	T	P	L	T	P	L	T	P		
<b>Semester I</b>																
22PCHCT-1.1	Inorganic chemistry-I	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCT-1.2	Organic chemistry-I	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCT-1.3	Physical chemistry-I	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-1.4	Analytical chemistry-I [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-1.5	Environmental Chemistry[Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-1.6	Industrial chemistry [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCP-1.7	Inorganic Chemistry Practical-I	--	--	02	02	--	--	7	--	--	7	--	--	36	050	
22PCHCP-1.8	Organic Chemistry Practical-I	--	--	02	02	--	--	7	--	--	7	--	--	36	050	
22PCHCP-1.9	Physical chemistry Practical-I	--	--	02	02	--	--	7	--	--	7	--	--	36	050	
22PCOE-1.0	Natural Product Chemistry	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
<b>Semester Total</b>		<b>20</b>	<b>--</b>	<b>06</b>	<b>26</b>	<b>75</b>	<b>--</b>	<b>21</b>	<b>75</b>	<b>--</b>	<b>21</b>	<b>350</b>	<b>--</b>	<b>108</b>	<b>650</b>	
<b>Semester II</b>																
22PCHCT-2.1	Inorganic chemistry-II	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCT-2.2	Organic chemistry-II	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCT-2.3	Analytical chemistry-II	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-2.4	Physical chemistry-II [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-2.5	Bioinorganic and Organometalic Chemistry [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-2.6	Polymer science and technology [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	

22PCHCP-2.7	Inorganic Chemistry Practical-I	--	--	02	02	--	--	7	--	--	7	--	--	36	050	
22PCHCP-2.8	Organic Chemistry Practical-I	--	--	02	02	--	--	7	--	--	7	--	--	36	050	
22PCHCP-2.9	Analytical chemistry Practical-I	--	--	02	02	--	--	7	--	--	7	--	--	36	050	
22PCOE-2.0	Drug discovery and dosage forms	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
<b>Semester Total</b>		<b>20</b>	<b>--</b>	<b>06</b>	<b>26</b>	<b>75</b>	<b>--</b>	<b>21</b>	<b>75</b>	<b>--</b>	<b>21</b>	<b>350</b>	<b>--</b>	<b>108</b>	<b>650</b>	
Course code	Course name	Credits				Marks										Remarks
						C1			C2			C3			Total	
		L	T	P	Total	L	T	P	L	T	P	L	T	P		
<b>Semester III</b>																
22PCHCT-3.1	Dosage forms and Drug regulations	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCT-3.2	Medicinal Chemistry-I	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCT-3.3	Spectroscopy [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-3.4	Molecular Biology [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-3.5	Basics of Biochemistry [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCP-3.6	Assay of Drug Molecules	--	--	02	02	--	--	7	--	--	7	--	--	36	050	
22PCHCP-3.7	Synthesis of Drug Molecules	--	--	02	02	--	--	7	--	--	7	--	--	36	050	
22PCOE-3.8	Drugs and Drug regulations	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
<b>Semester Total</b>		<b>16</b>	<b>--</b>	<b>04</b>	<b>20</b>	<b>60</b>	<b>--</b>	<b>14</b>	<b>60</b>	<b>--</b>	<b>14</b>	<b>280</b>	<b>--</b>	<b>72</b>	<b>500</b>	
<b>Semester IV</b>																
22PCHCT-4.1	Basics of Pharmacology and Pharmaceutics	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCT-4.2	Medicinal Chemistry -II	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-4.3	Bioorganic Chemistry [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-4.4	Nucleic Acids and Protein Biochemistry [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCSCT-4.5	Pharmaceutical Process chemistry [Optional]	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCOE-4.6	Pharmacology and therapeutic agents	04	--	--	04	15	--	--	15	--	--	70	--	--	100	
22PCHCP-4.7	Project	--	--	04	04	--	--	15	--	--	15	--	--	70	100	
														50	20	

<b>Semester Total</b>	<b>16</b>	<b>--</b>	<b>04</b>	<b>20</b>	<b>60</b>	<b>--</b>	<b>15</b>	<b>60</b>	<b>--</b>	<b>15</b>	<b>280</b>	<b>--</b>	<b>70</b>	<b>500</b>	
<b>Programme Total</b>	<b>72</b>	<b>--</b>	<b>20</b>	<b>92</b>	<b>270</b>	<b>--</b>	<b>71</b>	<b>270</b>	<b>--</b>	<b>71</b>	<b>1260</b>	<b>--</b>	<b>358</b>	<b>2300</b>	

L=Lecture,  
T= Tutorial,

**22PCHCT**= Pharmaceutical chemistry Hard Core Theory  
**22PCSCT**= Pharmaceutical chemistry Soft Core Theory  
project **P**=Practical

**22PCHCP** = Pharmaceutical chemistry Hard Core Practical  
**22PCHCP**= Pharmaceutical chemistry Hard Core  
**22PCOE**= Pharmaceutical chemistry open elective

**Note:** The project evaluation marks 70 are a total of 50(50% of Total marks) for dissertation and 20 (20% of Total marks) for viva.

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QUESTION PAPER PATTERN FOR  
M.Sc. PHARMACEUTICAL CHEMISTRY COURSE  
(for Hard core, Soft core and Open elective courses)

Course	: M.Sc. Pharmaceutical chemistry
Semesters	: 1/2/3/4
Title of the Paper	: -----
Time Duration	: 3 H
Maximum Marks	: 70
Instructions	: 1) Answer any <b>FIVE</b> sub questions questions from <b>PART-A</b> 2) Answer any <b>FIVE</b> questions from PART-B
Total No of Questions	: 8 questions
<b>PART-A</b>	: 1 Main Question in PART-A of 10 marks weightage with 7 sub-questions of 2 marks each
<b>PART-B</b>	: 7 Main Questions in PART-B of 12 marks each with sub question like a,b,c or a,b.

**MODEL QUESTION PAPER**  
**M.Sc. I/II/III/IV Semester Degree Examination (month )(Year)**  
**PHARMACEUTICAL CHEMISTRY**  
**Paper-PCHC-1.1-(L)- Inorganic chemistry-I**

**Time: 3 H**

**Max.Marks: 70**

- Instructions: 1) Answer any **FIVE** questions from PART-A  
2) Answer any **FIVE** questions from PART-B

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**PART-A**

1. Answer any FIVE questions of the following 5x2=10
- a.
  - b.
  - c.
  - d.
  - e.
  - f.

**PART-B**

- Answer any FIVE main questions of the following 5 x 12= 60
2. x+x+x=12
- a.
  - b.
  - c.
3. x+x+x=12
- a.
  - b.
  - c.
4. x+x+x=12
- a.
  - b.
  - c.
5. x+x+x=12
- a.
  - b.
  - c.
6. x+x+x=12
- a.
  - b.
  - c.
7. x+x+x=12
- a.
  - b.
  - c.
8. x+x+x=12
- a.
  - b.
  - c.

M.Sc. I semester Pharmaceutical Chemistry syllabus  
Paper-PCHC-1.1- (L) - Inorganic Chemistry-I

**UNIT-I: PERIODIC PROPERTIES:**

**Review of Periodicity:** Atomic size, ionic radii, ionization potential, electron affinity and electronegativity. General characteristics of s,p,d and f block elements- comparative studies with reference to electronic configuration, various oxidation states, trends in physical and chemical properties and complexation tendencies

**Transition elements:** characteristic properties, correlation with electronic configuration, 3d, 4d and 5d series, trends in their chemistry.

**Lanthanides and actinides:** General properties, electronic configuration, stable oxidation state. Lanthanide contraction and its causes. Comparison of general properties of lanthanides with 3d and 4f block elements. General properties of actinides, actinide contraction comparison of actinides with lanthanides.

**16 Hours**

**UNIT-II: CHEMICAL BONDING –I:**

Introduction to chemical bonding, atomic orbitals molecular orbitals, types of bonds with examples.

**Ionic bonding:** introduction, structure of ionic solids, properties of ionic solids, ionic radii, factors affecting ionic radii, radius ratio rules. Types and structures of simple ionic compounds- NaCl, CsCl. Lattice energy. Born-Landé equation. Born-Haber cycle- its applications, size effects, polarizing power and polarizability of ions. Fajan's rule, covalent character in ionic compounds. Hydration energy and solubility of ionic solids.

**16 Hours**

**UNIT-III: CHEMICAL BONDING-II:**

**Covalent Bond:** Valence bond theory, orbital overlap, molecular orbital theory, symmetry and overlap, molecular orbital diagrams of diatomic molecules (Homo and Hetero nuclear), triatomic molecules, linear (CO<sub>2</sub>, N<sub>2</sub>O) and Angular (NO<sub>2</sub>), Walsh diagrams, bent rule, some reactions of covalently bonded molecules, resonance, hybridization, VSEPR theory, molecular geometries

**Metallic bonding:** Characterization of metallic states, Valence Bond approach, Band theory, conductors, insulators, semiconductors, defects in solids.

**16 Hours**

**UNIT-IV: ACIDS AND BASES:**

Introduction, different definition, solvent system and leveling effects. Generalized acid base concepts (Basicity of metal acids, hydration and hydrolysis). Relative strength of acids and bases, steric effect (back strain, front strain and internal strain). Solvation effect with reference to liquid ammonia, anhydrous sulfuric acid acetic acid and liq. Sulfur dioxide.

**Hard, soft acids and bases:** classification, strength of hardness and softness. Irving Williams series, theoretical basis of Hardness and softness.

**16 Hours**

### **PCHC1.1-(P)-Inorganic Chemistry-I**

A] Semi micro qualitative inorganic analysis of a mixture, containing two cations and two anions including one less common cation such as Mo, Ti, Zr, Ce, V and Li.

B] Determination of total hardness, temporary hardness and permanent hardness of water by EDTA titration.

#### **Books:**

- 1) Advanced Inorganic Chemistry- F.A.Cotton and Wilkinson, John Wiley.
- 2) Chemistry of elements – N.N.Greenwood and A.Eamshaw Pergaman.
- 3) Concise Inorganic Chemistry –J.D.Lee. E:BS.
- 4) Inorganic Chemistry, Principles and Reactivity –J.E.Huheey, Harper and Row.
- 5) Modern Aspects of Inorganic Chemistry –H.J.Emuleus and A.G. Sharpe. ELBS.
- 6) Theoretical Inorganic Chemistry –M.C.Day, Jr and J.Selbin, East west press.
- 7) Concepts and models in Inorganic Chemistry –Dougals, McDanial and Alexander John Wiley and sons.
- 8) Inorganic Quantitative Analysis –A.I.Vogel ELBS.
- 9) Fundamentals of Analytical Chemistry –D.A.Skoog, D.M.West and F.T.Holler, Saunder college publication.
- 10) Analytical Chemistry –S.Usharani Macmillan Indian Ltd.
- 11) Chemical Semimicro Analysis –V.N.Alexeyev. Mir Publishers (Moscow)
- 12) Vogel's Qualitative Inorganic Analysis, Revised by G.Suchla Longarman Groups Ltd.

M.Sc. I semester Pharmaceutical Chemistry syllabus  
Paper-PCH-1.2- (L)-Organic Chemistry-I

**UNIT-I: BONDING IN ORGANIC MOLECULES:**

Valence bond approach, orbital overlaps, resonance and hybridization, bond length, bond angles and shapes of molecules. Molecular orbital theory- LCAO methods, sigma, pi and delta molecular orbitals. MO-treatment, Homo and Hetero diatomic molecules, MO treatment of delocalized pi bonding systems, polarity of covalent molecules, bond energies (bond dissociation),

**Hydrogen bonding-** definition types of hydrogen bonding with examples, significance of hydrogen bonding

**Localized chemical bonding:** hybridization index, bonding in cyclopropane, bond distances, bond angles, bond energies, calculation of heats of reactions and bond order.

**Delocalized chemical bonding:** conjugation, cross conjugation, steric inhibition of resonance, hyper conjugation, tautomerism, valence tautomerism. Bonding in fullerenes, bonding weaker than covalent: hydrogen bonding, inclusion compounds, complexes of crown ethers. catenanes rotaxenes

**16 Hours**

**UNIT-II: STEREOCHEMISTRY**

Optical isomerism, element of symmetry, chirality, optical isomerism of compounds containing one or more than one chiral centre. projection formulae- Fischer, Saw-horse, Newman and flying wedge projection and their interconversions. Threo and erythro isomers, enantiomers and epimers, epimerization,. D-L and R-S conventions. E-Z nomenclature. Conformational analysis of ethane, propane, butane and cyclohexane (chair and boat) and mono substituted cyclohexane. **Stereoselective synthesis:** terminology, Cram's rule (open chain, cyclic and chelate and dipolar models), prologs rule. Strategy of stereoselective synthesis. Acyclic stereoselection. Enantioselective synthesis, diastereoselection in cyclic compounds. Stereoselective formation of double bond, stereoselective cyclization of polyenes.

**16 HOURS**

**UNIT-III: AROMATICITY:**

Aromaticity. Difference between aromatic and non aromatic compounds. Huckel's rule-HMO theory, energy level diagrams, Mobius systems, benzenoid and nonbenzenoid aromatic compounds, tropones and tropolones, borazines, azulenes pyrilium cation ferrocene. Alternant and nonalternant hydrocarbons. Aromaticity of charged rings (3-8 membered) non aromatic antiaromatic and homoaromatic systems. Physical methods for the determination of aromaticity-X-ray, UV, and NMR methods. Ring current as criteria for aromaticity. Annulenes and heteroannulenes [10-18].

**16 Hours**

**UNIT-IV: REACTION MECHANISM:**

Homolysis and heterolysis of covalent bonds. Types of organic reagents. Reactive intermediates. Formation, structure stability and reactions of carbocations, carbanions, free radicals, nitrenes, carbenes and arene-intermediates. Types of reactions: substitution reactions- Nucleophilic (SN<sub>1</sub> and SN<sub>2</sub>), Electrophilic, addition reactions, elimination reactions (E1 and E2). Thermodynamic and kinetic requirements of reactions, Methods of determination of reaction mechanism (kinetic and non kinetic methods). Identification of products, detection of intermediates, stereochemical evidences, study of catalysts, isotopic labeling,.



**PCHC-1.2-(P)-Organic chemistry-I**

Preparations;

- 1) Acetanilide from Aniline (Acylation)
- 2) P-bromoacetanilide from acetanilide (Halogenation/bromination)
- 3) p-bromoaniline from p-bromoacetanilide (Hydrolysis)
- 4) Aniline from Nitrobenzene (Reduction)
- 5) Aryloxy acetic acid from phenol (Substitution reaction)
- 6) Benzoic acid and Benzylalcohol from benzaldehyde (cannizaro reaction)
- 7) Methyl orange from aniline (diazotization)

Estimations:

- 1) Estimation of acid and amide.
- 2) Estimation of Acid and ester.
- 3) Determination of equivalent weight of base by base hydrochloride method.

**Books:**

- 1) Advanced organic chemistry –reactions, Mechanisms and structure – Jerry March.
- 2) Reaction Mechanism in Organic Chemistry – S. M. Mukherji and S. P. Singh.
- 3) Organic Chemistry Vol I & II –L. Finar.
- 4) Named Reactions in Organic Chemistry – Surrey.
- 5) Vogel's Text book of practical organic chemistry- B S Furness, A J Hannaford, PWG smith
- 6) Organic name reactions and rearrangement- S N sanyal
- 7) Organic name reactions- Gurdeep Raj
- 8) practical organic chemistry- Ahluvalia

M.Sc. I semester Pharmaceutical Chemistry syllabus  
Paper PCHC-1.3-(L):- Physical Chemistry

**UNIT-I-A: ELEMENTARY QUANTUM CHEMISTRY:**

Black body radiation, planks theory, photoelectric effects, Compton effect, De-Broglie`s hypothesis, Heisenberg`s uncertainty principle, postulates of quantum mechanics, operator concepts, Eigen values and Eigen functions. Schrodinger wave equation, elementary application to particle in one dimensional box, hydrogen atom, Rigid rotator and harmonic oscillator.

**10 HOURS**

**B:THERMODYNAMICS:**

Brief resume of concepts of law of thermodynamics, free energy, chemical potential and entropy, Gibbs Helmholtz equation and Maxwell`s relation.

**6 HOURS**

**UNIT-II: CHEMICAL DYNAMICS:**

A brief review on basic concepts and terminology in reaction kinetics, methods of determining rate laws. Arrhenius equation, collision state theory for bimolecular reaction rates. Transition state theory, comparison between collision and transition state theories. Lindmann theory of unimolecular reaction rates, concept and significance of energy of activation. Dynamics in solutions, ionic reactions, effect of ionic strength, primary and secondary salt effects.

**16 HOURS**

**UNIT-III: ELECTROCHEMISTRY:** Activity and activity coefficient, Mean activity coefficient. Debye-Huckel limiting law (qualitative aspects only).assumptions, ionic strength, thickness of ionic atmosphere, concept of pH, pKa, pKw, buffer action and capacity. Buffer solution, Handerson-Hassalback equation and its application in preparation of buffer. Importance of buffers in biological systems. Pharmaceutical buffer solutions. Standard buffer solutions. Buffer system of the body.

**16 HOURS**

**UNIT-IV: DIFFRACTION STUDIES:**

X-ray diffraction: crystallographic systems, space lattice, reciprocal lattice, Bravis lattice, unit cell, Weiss indices, miller indices, braggs equation, single crystal rotation method, powder method, structure factor and determination of molecular parameter. Fourier series, Fourier refinement, phase problem.

Electron diffraction:- Introduction and scattering intensity Vs scattering angle, Wiel equation, radial distribution function and refinement of radial distribution function, rotation sector methods.

Neutron diffraction:- Introduction, scattering of neutrons by solids and liquids. Differences between neutron and X-ray diffraction.

**16 HOURS**

### **PCHC-1.3-(P)-Physical chemistry-I**

1. Determining adsorption isotherm
2. Determination of rate constant and energy of activation of first order reaction
3. Determination of molecular weight of polymer by viscometer.
4. Determination of dissociation constant of monobasic acid potentiometrically
5. Determination of percentage composition of given acid mixture conductometrically.
6. Determination of amount of  $\text{CuSO}_4$  present in the given solution using spectrophotometer
7. Conductometric titration of a weak acid with weak base strong acid with weak base.

### **Books:**

1. Quantum Mechanics – Chatwal and Anand.
2. A Textbook of Quantum Mechanics – P.M.Mathews and K.Venkateshhan.
3. Problems in Quantum Mechanics –G.L.Squires.
4. Quantum Chemistry – P.W.Alkins.
5. Valence – C.A.Coulson.
6. Physical Chemistry - P.W.Alkins.
7. Electro chemistry - S.Glasstone.
8. Physical Chemistry – G.K.Vemulapalli.
9. Thermodynamics – R.P.Rastogi and S.S.Mishra.
10. Chemical Kinetics - Laidler.
11. Practical Physical Chemistry – Khosla and others.
12. Practical Physical Chemistry – Findaly.
13. Experiments In Physical Chemistry – Wilson, Newcomb and others.
14. A collection of general chemistry experiments - A.J.Elias.
15. Chemicals and Electrochemical cells – Narayan and Vishwanathan
16. Introduction to Quantum chemistry – A.K.Chandra

M.Sc. I semester Pharmaceutical Chemistry syllabus  
Paper PCSC-1.4-(L)-Analytical Chemistry

**UNIT-I: SOLVENT EXTRACTION:**

Solvent extraction: General discussion, principle, factors affecting solvent extraction, quantitative treatment of solvent extraction, synergistic extraction, ion association complex, extraction reagents: acetyl acetone, 8-hydroxy quinoline, Dimethyl glyoxime, 1-nitroso -2-naphthal, cupferron, dithazole, sodium diethyl dithiocarbamate, ammonium pyrrolidinedithiocarbamate, tri-n -butylphosphate, poly (macrocylic) compounds, acetyltrimethyl ammonium bromide. Some practical considerations: choice of the solvent, extraction, stripping, completion of the analysis, automation of solvent extraction. Some applications: Determination of iron as 8-hydroxy quinolate, determination of lead by dithiazone method, determination of molybdenum by-thiocyanate method

**16 HOURS**

**UNIT-II: ACID BASE TITRATION:**

Principles of titrimetric analysis, titration curves for strong acid strong base, weak acid-strong base and weak base strong acid titrations. Poly protic acids, poly equivalent bases, determining the equivalence point-theory of acid base indicators, colour change range of indicator, selection of proper indicator.

**Application of acid-base titrations:** Determination of nitrogen, sulphur, ammonium salts, nitrates, and nitrites, carbonates and bicarbonates, and organic functional groups like carboxylic acid, sulphonic acid, amine, ester, hydroxyl, carboxyl groups, air pollutants like SO<sub>2</sub>.

**16 HOURS**

**UNIT-III: ION EXCHANGE METHODS:**

Ion Exchange methods: introduction, Definitions, principle, cation exchangers, anion exchangers and their synthesis, regeneration, ion exchange columns used in chromatographic separation, selection, of suitable systems, ion exchange capacity, ion exchange technique: Bath method, column method. Application of ion exchangers: separation of similar ion from one another, removal of interfering radicals, softening of hard water, complete demineralization of water, separation of lanthanides, separation of actinides, purification of organic compounds extracted in water, separation sugars, separation sugar, separation amino acids, preparation of pure reagents, hydro metallurgy.

**16 HOURS**

**UNIT-IV: INSTRUMENTAL METHODS OF ANALYSIS:**

Conductometry : Theory- Measurement of Conductivity - Basis for Conductometric titrations - Conductometry as an analytical tool. **Potentiometry** : Principles - Reference electrodes - indicator electrodes, selective electrodes - measurement of cell emf - potentiometric titrations. **Voltammetry** : Polarography - Direct current Polarography - Theory - Dropping Mercury Electrode- Quantitative technique - Measurement of Wave Heights - Pulse Polarography - Rapid Scan Polarography - Stripping Voltammetry - Cyclic Voltammetry. **Amperometry** : Principles, amperometric titrations with examples.

Electrogravimetry: Theory, completeness and nature of the deposit, instrumentation, electrolytic separation of metals and applications..

**16 HOURS**

Books :

1. Standard methods of chemical analysis. J. Welcher (Part-B), Robert E. Krieger publishing Co. USA 1975.
2. A text book of inorganic analysis by A I Vogel.
3. Chemical Methods of analysis by Snell and Snell.
4. Practical ecology, K S Rao, Anmol Publications Pvt Ltd New Delhi.
5. Laboratory manual for Environmental chemistry Sunita Hooda and Sumanjeet Kaur

M.Sc. I semester Pharmaceutical Chemistry  
Paper PCSC-1.5-(L)- Environmental Chemistry

**UNIT-I: ENVIRONMENT**

Vertical temperature, heat budget of the earth and atmosphere system, vertical stability of atmosphere. Biogeochemical cycle, bio distribution of elements –C, N, P, S and O.

Partical ions, particles and their formation in atmosphere, chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effects, pollution by chemicals, petroleum, minerals. Chemical solutions for environmental problems, biodegradability, principles of decomposition, better industrial processes, Bhopal gas tragedy, Chernobil, Sewozo an minamata disasters.

**16 HOURS**

**UNIT-II: AIR POLLUTION:**

**Air pollution analysis.** Historical overview-global implications of air pollution, sources of pollutants, classification of pollutants. Sources and effects of particulates, carbon monoxide, sulpher oxides, nitrogen oxides, hydrocarbons and photochemical oxidants on human health, vegetation and materials standards for air pollutants.

**Air Quality Monitoring:** Sampling methods and devices for particulates and gaseous pollutants.

SO<sub>2</sub>. Ambient air measurements and stock gas measurements-turbidimetric, colorimetric and conductometric methods. NO<sub>x</sub>: Griees. Ilosvay and Jacobs-Hockheiser. Ccolorimetric methods, chemiluminiscent technique. CO: NDIR amperometric, FID and catalytic oxidation methods.

**Air pollution control:** atmospheric cleaning processes, approaches to contaminant control-detection and control at source.

**16 HOURS**

**UNIT-III: WATER POLLUTION:**

**Water pollution and analysis:** water resources, origin of waste water, types of water pollutants, their sources and effects. Chemical analysis for water pollution control-objectives of analysis, parameters of analysis, sample collection and preservation. Environmental and public health significance and measurement of color, turbidity, total solids, acidity, alkalinity, hardness, chloride, residual chlorine, chlorine demand, sulphate, fluoride, phosphates and different forms of nitrogen in natural and in waste/polluted waters. Heavy metal pollution-public health significance of Pb, Cd, Cr, Hg, As, Cu, Zn and Mn. General survey of the instrumental techniques for the analysis of heavy metals in aquatic systems organic loadings-significance and measurement of DO, BOD, COD, DOD and TOC, Phenols, pesticides, surfactants, tannin and lignin as water pollutant and their determination.

**16 HOURS**

**UNIT-I: WASTE WATER TREATEMENT:**

Waste water characteristics, effluent standards, terminology in waste water treatment. Treatment of domestic waste water. **preliminary treatment-** Sedimentation, equalization, neutralization.

**Secondary treatment-** Aerated lagoons, tricliling filters activated sludge process, oxidation ditch, oxidation pond and anaerobic digession. Sludge treatment and disposal.

**Tertiary treatment-** Evoporation, ion exchange, adsorption, electro dialysis, electrolytic recovery and reverse osmosis.

**Advanced waste water treatment-** netriant removal- nitrogen and phosphorous removal – solid removal

**16 HOURS**

Books

1. Environemtnal Chemistry- S E Manahan
2. Environmental chemistry- Sharma and Kour
3. Environmental chemistry- A K Dey
4. Environmental pollution analysis- S M Khopkar
5. Standard Methods of chemical analysis- F J Vulcher
6. Environmental toxicology- Ed J Rose.
7. Environmental chemistry- C Baird. W H Freeman
8. Chemical analysis of Airborne particles- Ed. S Landburger and M Creachman

M.Sc. I semester Pharmaceutical Chemistry  
Paper PCOE-1.7-(L)- Natural products chemistry

**UNIT-I: ALKALOIDS**

**Alkaloids:** Introduction, occurrence, function of alkaloids in plants, nomenclature and pharmaceutical applications. Isolation and general methods of structural elucidation. Structure elucidation and synthesis of following alkaloids- Morphine, Ephedrine, Nicotine, Cocain, Papavarine, Reserpene, Phytochemical tests for alkaloids.

**16 HOURS**

**UNIT-II: VITAMINS AND ESSENTIAL OILS**

Introduction classification, properties biological significance of vitamins. Synthesis and biological importance (occurrence, chemical properties, deficiency and excess defects), of following vitamins: thiamine (B1), Ascorbic acid, Pantothenic acid (B5), vitamin A, Vit-B6, Tocopherols (E) and Biotin (B7).

**Essential Oils:** introduction, definition, chemical nature, classification general methods of extraction, chemical constituents and uses of clove oil, cinnamon oil, coriander oil, eucalyptus oil, sandal wood oil their methods of production and analysis.

**16 HOURS**

**UNIT-III: GLYCOSIDES AND TERPENOIDS**

**Glycosides:** introduction, definition, general characters and classification of glycosides. Study of general methods of isolation and uses of the following: cardiac glycosides, anthracene glycoside, saponin, synogenetic glycosides and flavone glycosides.

**Terpenoids:** general introduction, classification, isolation purification and structural elucidation of menthol, camphor, pinene, cariphilin, santonin and squalene. Biological importance of terpenoids.

**16 HOURS**

**UNIT-IV: STEROIDS AND PROSTAGLANDINS**

**Steroids;** introduction nomenclature, structure and synthesis of cholesterol, female and male sex hormones- structures, their significance development of antifertility agent. Biological importance of bile acids, estrone, progesterone, testosterone, androsterone and corticosterone. Biosynthesis of cholesterol.

**Prostaglandins:** introduction, occurrence, nomenclature, classification, synthesis and structure elucidation of PGE-I, Synthesis of PGE and F series. Biological significance of prostaglandins.

**16 HOURS**

**BOOKS**

1. Natural products chemistry-nakanishi golo
2. Organic chemistry of natural products vol-I and II – Gurdeep chatwal
3. Organic chemistry, Vol-I and II –Finar
4. Introduction to quantitative drug design- Y C Martin



5. Comprehensive medicinal chemistry- corwin and Hansch
6. Medicinal chemistry-Burgers (Vol-I-VI)
7. Principles of medicinal chemistry-William O Foye
8. Strategy of drug design- Brucell
9. The organic chemistry of drug design and drug action- Recharad B
10. Pharmaceutical analysis-Higuchi, Bechmann and Hassan
11. Text book of pharmaceutical analysis- K A Conners
12. Vogel`s text book of Quantitative chemical analysis, Sixth edition-RC denny, J D Barnes, N J K Thomas and Others
13. Practical pharmaceutical chemistry-IV eedition, Part-I And II- Beckett and Stenlaker
14. Practical chemistry- Dr. O P Pandey, D N Bajpai and Dr. S Giri
15. Pharmaceutical analysis- david G Watson
16. Principles of analytical chemistry-John H kenedy

M.Sc. II semester Pharmaceutical Chemistry syllabus  
Paper-PCHC-2.1- (L)-Inorganic Chemistry-II

**UNIT-I: COORDINATION CHEMISTRY**

Introduction, types of ligands, chelating, bridging and microcyclic ligands. Nomenclature and isomerism in metal complexes. Valence bond, crystal field and Molecular Orbital Theories (Salient features). Crystal field splitting of 'd' orbitals in octahedral, tetrahedral, tetragonal and square planar fields. Magnitude of  $\Delta$ , CFSE, spectrochemical series. Shortcoming of CFT, evidence for covalency (ACFT). Jahn-Teller Distortion in coordination compounds. Molecular orbital treatment of coordination compounds involving sigma bonding. Magnetism:- types of magnetism; magnetic susceptibility; spin only moment; orbital contribution to spin only moment.

**16 HOURS**

**UNIT-II: ORGANOMETALLIC COMPOUNDS**

Introduction, 18 electron and 16 electron rules, reactions of metal alkyls, aryls and olefin complexes. Reactions of organometallic complexes-substitution reactions, oxidative addition and reductive elimination reactions, insertion and elimination reactions.

Catalysis by organometallic complexes: alkene hydrogenation (Wilkinson's catalyst) "hydroformylation" water gas shift reaction, Monsanto acetic process, the Walker process, synthetic gasoline and Ziegler-Natta catalysis.

**16 HOURS**

**UNIT-III: ELEMENTS OF SYMMETRY AND GROUP THEORY**

Introduction to symmetry with examples, molecular geometry and symmetry operations, symmetry elements: Rotational axis of symmetry, plane of symmetry, improper rotational axis of symmetry, inversion centre (or centre of symmetry) and identity elements. Important relations of symmetry elements, deducing the implied presence of other symmetry elements- $C_n$  ( $n$ = even or odd),  $S_n$  ( $n$ =even) and  $S_n$  ( $n$ =odd). Mathematical requirement for a molecular point group, subgroups and . Nomenclature of the point group and identification of the molecular point group of molecules.

**16 HOURS**

**UNIT-IV: CHEMISTRY OF NON TRANSITION ELEMENTS**

General discussion on the properties of non-transition elements. Special features of individual elements (C N O and halogen family). Polymorphism of carbon, phosphorus and sulfur. Synthesis, properties and structures of boranes, carbonyls and metallocarbonyls; silicones, phosphazenes, sulfur nitrogen ring compounds, peroxyacids of nitrogen, phosphorus, sulfur and halogens; inter halogen compounds; chemistry of noble gas compounds (Xenon fluorides).

**16 HOURS**

## **PCHC-2.1-(P)-Inorganic Chemistry Practical**

A] Quantitative analysis: separation and determination of two metal ions involving volumetric and gravimetric methods from the following.

1. Fe + Ni
2. Cu + Fe
3. Ca + Fe

B] Preparation of complexes

- 1) Chloropentamincobalt(III)chloride
- 2) Tris(acetylacetonato)copper(II)sulphate
- 3) Mercuritetrathiocyanatocobaltate(II)

### **Books:**

- 1) Principles of structure and reactivity – J.E.Hubeey, Harper and Row.
- 2) Concise inorganic Chemistry –J.D.Lee.
- 3) Elements of nuclear chemistry –R.Gopalam.
- 4) Vogel's text book of quantitative inorganic Analysis –J.Basett, R.C.Denny.
- 5) Sources Books on Atomic Energy –S.Glanstone Van Nostrand.

M.Sc. II semester Pharmaceutical Chemistry syllabus  
Paper-PCHC-2.2-(L)- Organic Chemistry-II

**UNIT-I: A- NAME REACTIONS AND REARRANGEMENTS:**

**Name reactions:** Aldol condensation, Claisen condensation, Dieckmann reaction, Friedel-Crafts reaction, Reimer-Tiemann reaction, Wolf-Kishner reduction. **Rearrangements:** Hofmann, Fries, Cope, Pinacol-Pinacolone.

**B- REAGENTS IN ORGANIC SYNTHESIS:**

Dicyclohexylcarbodiimide (DCC), Lead tetra acetate (LTA), Osmium tetroxide (OT), DDQ, Selenium dioxide, Phase transfer catalysts in organic synthesis.

**16 Hours**

**UNIT-II: HETEROCYCLIC COMPOUNDS**

Introduction, IUPAC nomenclature of heterocyclic ring systems (3-7 membered rings) containing upto 3 hetero atoms. Aromatic and nonaromatic heterocycles. Methods of synthesis and chemical reactions of pyrrole, furan, thiophene and pyridine with particular emphasis on the mechanism of electrophilic and nucleophilic substitutions. Acidity and basicity of pyrrole and pyridines.

Introduction to condensed 5 and 6 membered heterocycles. Synthesis and reactions of Indole, Benzofuran, Quinoline, Coumarins, Chromones and Flavones

**16 HOURS**

**UNIT-III: PERICYCLIC REACTIONS**

Molecular orbitals and their symmetry properties, Frontier molecular orbital of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions.

**Electrocyclic reaction-** FMO approach, correlation diagrams Woodward-Hofmann rules, conrotatory and disrotatory reactions,  $4n$ ,  $4n+2$ , pi electron systems. **Cycloaddition reactions-** antarafacial and suprafacial additions.  $4n$  and  $4n+2$  pi electron systems.  $2+2$  additions of ketenes, 1,3-dipolar addition and chelation reaction. **Sigmatropic rearrangement-** superficial and antarafacial shifts of hydrogen atom. sigmatropic shifts involving carbon moieties 3,3 and 5,5-sigmatropic rearrangements, Claisen, Cope and Aza Cope rearrangements.

**16 HOURS**

**UNIT-IV: COMBINATORIAL CHEMISTRY**

Introduction to combinatorial synthesis combinatorial libraries, size of compound libraries, principles of combinatorial synthesis. Comparison of traditional synthesis and combinatorial synthesis. One step combinatorial synthesis and multistep combinatorial synthesis with examples. Methods of combinatorial synthesis-solution phase synthesis, solid phase synthesis, parallel and multipin synthesis, split and mix synthesis, Merrifield solid phase synthesis. Comparison of combinatorial synthesis in solution phase with solid phase synthesis. Parallel synthesis. Identification and isolation of active constituents.

**16 HOURS**

### **PCHC-2.2-(P)-Organic chemistry**

Separation of binary mixture and systematic qualitative analysis of individual compounds

#### **Books:**

- 1) Heterocyclic Chemistry – J.Joule and G.Smith.
- 2) Introduction to chemistry of Heterocyclic compounds –Acheson.
- 3) Organic Chemistry Vol I & II – I.L.Finar.
- 4) Modern Methods of Organic synthesis – House
- 5) Reactions Mechanism and Reagents in Organic Chemistry - G.R.Chatwal.
- 6) Stereochemistry of carbon compounds –E.L.Eliel.
- 7) Stereochemistry of Organic Compounds – P.S.Kalsi.
- 8) Heterocyclic chemistry- R K Bansal
- 9) Stereochemistry of carbon compounds- Nasipuri
- 10) quantitative chemical semimicroanalysis- V N Alexeyo
- 12) Practical chemistry- Dr. O P Pandey, D. N. Bajpai and Dr S Ggiri

M.Sc. II semester Pharmaceutical Chemistry  
Paper PCHC-2.3-(L)-Analytical Chemistry-II

**UNIT-I: STATISTICAL TREATMENT OF ANALYTICAL DATA**

Introduction, The sampling steps, method of sampling solids, liquids and gases. Effects of uncertainties in sampling, sampling hazards. Errors in analysis, classification of errors, systematic errors-sources, effects and reduction. Random errors-sources, effects and reduction. Accuracy and precision. Statistical treatment of finite samples, mean median, average deviation, std deviation, variance and student t-test (comparing two means and standard deviations) significance of testing.

**16 HOURS**

**UNIT-II: GRAVIMETRIC AND VOLUMETRIC METHODS OF ANALYSIS**

General principles, stoichiometry, calculation of results from gravimetric data. Properties of precipitates. Nucleation and crystal growth, factors influencing completion of precipitation. Coprecipitation and post precipitation, purification and washing of precipitates. Precipitations from homogeneous solution, a few common gravimetric determinations- chloride as silver chloride, sulphate as barium sulphate

Acid Base titration: Principles of titrimetric analysis, titration curves for strong acids and strong base, weak acid strong base and weak base strong acid titration, polyprotic acids, polyequivalent bases, determining the equivalence point theory of acid base indicators, colour change range of indicator, selection of proper indicator.

**16 HOURS**

**UNIT-III: PRECIPITATION AND COMPLEXOMETRIC TITRATION**

**Precipitation titration:** titration curves, feasibility of precipitation titrations, factors affecting shape-titrant and analyte concentration, completeness of the reaction, titrants and standards, precipitation titrations involving silver nitrate, the Volhard, the Mohr and the Fajan`s methods, typical applications.

**Complexometric titrations:** complex formation reactions, stability of complexes, stepwise formation constants, chelating agents, EDTA- properties, complexes with metal ions, equilibrium calculations involving EDTA, conditional formation constants, derivation of EDTA titration curves, effect of other complexing agents, factors affecting the shape of the titration curves-completeness of reaction. Indicators for EDTA titrations- theory of common indicators. Titration methods employing EDTA-direct, back and displacement titrations.

**16 HOURS**

**UNIT-IV: FLAME PHOTOMETRY AND AAS**

Energy level diagram- atomic absorption spectra. Flame characteristics, flame atomizer and electrothermal atomization. Comparison of spectral interferences, chemical and physical interferences in flame photometry and AAS. Use of organic solvents, quantitative technique-calibration curve procedure and the standard addition technique. Typical commercial instruments for flame photometry and AAS. Applications, quantitative analysis and quantitative evaluations. Relative detectabilities of atomic absorption and flame emission spectroscopy.

**16 HOURS**

### **PCHC-2.3-(P)- Analytical chemistry practical**

1. Analysis of Sodium carbonate and Sodium bicarbonate in baking soda by acid base titration
2. Determination of calcium in lime stone by redox titration
3. Analysis of chloride in natural and polluted water by argentometric titration
4. Assay of calcium in milk powder by EDTA titration
5. Determination of Iodine value of oil
6. Analysis of copper in Ore or alloy by iodometric titration
7. Estimation of aspirin, paracetamol and caffeine in drug formulation

### **Books**

1. Basic concepts of analytical chemistry-S M Khopkar
2. Fundamentals of analytical chemistry- Skoog and West
3. Analytical chemistry, V edition- G D Christian
4. Quantitative analysis- R A Day and A L Underwood
5. Environmental chemistry- A K Day
6. Vogel's textbook of quantitative chemical analysis- J Mendham, R C Denny, J D Barnes and et al
7. Analytical chemistry principles- John H kenedy. II edition
8. Instrumental methods of chemical analysis-V edition- Chatwal and anand
9. Chromatography-v edition- E Heftmen
10. Chromatography today- Poole and S K Poole

M.Sc. II semester Pharmaceutical Chemistry  
Paper PCSC-2.4-(L)- Physical Chemistry-II

**UNIT-I: SOLID STATE CHEMISTRY AND NANO MATERIALS**

**Solid state reaction:** general principles, experimental procedures, co-precipitation as precursor to solid state reactions. Ceramics- general aspects of electronic, magnetic ceramics, structure of spinels and garnets, high temperature super conductors, layer compounds. A brief discussion of thermal, electrical, dielectric, magnetic and optical properties of ceramic materials.

Composites: general characteristics, classification of composite materials. Dispersion strength of composite materials. Fiber-reinforced composites. Specialty solid materials- fast ion conductors, storage material, Langmuir-Blodgett films, liquid crystals intercalation compounds. Nanocrystalline phase, preparation procedures, special properties and applications.

**16 HOURS**

**UNIT-II: POLYMER CHEMISTRY**

Review of polymers, basic concepts and classification of polyenes- monomer, repeat units, linear, branched, cross linked, straight copolymers and networks and interpenetrating networks (IP). Degree of polymerization. Molecular weight distribution-average molecular weight concept, number average, weight average, viscosity average and Z average molecular weights. Determination of molecular weights, osmotic pressure method, viscosity method, light scattering (Debye and Zimm's plots), ultracentrifugation method, polydispersity and molecular weight distribution. Commercial importance of polymers.

**16 HOURS**

**UNIT-III: PHOTOCHEMISTRY**

Activation of thermal and photochemical reactions. Light absorption and excitation, singlet and triplet states. Morse curves, Frank codon principle. De-Excitation processes, Jablonski diagram, Photophysical pathways, fluorescence and phosphorescence. Photosensitization (Donor, acceptor concept, resonance, collision and transfer). Chemical processes, quantum yield and quantum efficiencies. Variation in singlet and triplet states. Phenomenon of optical pumping, remote fictionalization (Barton reaction).

Photochemistry of olefins: cis-trans isomerization, (2+2), cycloaddition and rearrangements. Reactions of conjugated olefins and di-methane rearrangements.

**16 HOURS**

**UNIT-IV: SURFACE CHEMISTRY AND CATALYSIS**

Adsorption, types of adsorption, adsorption isotherms, Langmuir-Freundlich, Bet and Gibbs adsorption isotherms, adsorption with dissociation, competitive adsorption. Mechanism of unimolecular and bimolecular surface reactions. Homogeneous catalysis- principle of general and specific acid base catalysis, linear free energy relation and acidity function, salt effect and base catalysis. Heterogeneous catalysis; study of solid surfaces, employing surface technique viz.. Bet and N<sub>2</sub> adsorption. Enzyme catalysis- single substrate mechanism, michaelis-menten equation. Effect of pH, temperature and inhibition.

**16 HOURS**



**Books:**

1. Quantum chemistry –P.W.Atkins.
2. Valance –C.A.Coulson.
3. Physical Chemistry – P.W.Atkins.
4. Thermodynamics- L.M.Klotz and R.M Rosenberg.
5. Thermodynamics – P.R.Rastogi and S.S.Mishra.
6. Principles of polymers science –P.Bahadur and N.V.Shastry.
7. Polymer Chemistry –Billymer.
8. Chemical Kinetics – Laidler.
9. Introduction to solids –L.V.Azarof.
10. Colloidal Chemistry – Volytsky.
11. Solid State Chemistry – A.R.West.
12. X-rays diffractions – Klug and Alexander.
13. Elements of X-rays diffractions – Cullity.
14. 16) Findaly's Practical Physical Chemistry.
15. 18) Experiments of Physical Chemistry – shoemaker and Garland.
16. 19) Chemical and Electrochemical cells – Narayan and Vishwanatham

M.Sc. III semester Pharmaceutical Chemistry  
Paper PCHC-3.1-(L)- Dosage forms and drug regulations

**UNIT-I: DOSAGE FORMS:**

Different dosage forms. Oral solids, oral liquids, solution properties, suspensions, emulsions, parenterals, aerosols, inhalation products, topical semisolids, typical liquids and powders, ophthalmic products, rectal vaginal products, oral solids-tablets, types of solids, methods of tablet production-wet granulation, coating of tablets. Quality control methods and measurement of tablet properties. Oral liquids- introduction, types, oral suspensions and oral emulsions

**16 HOURS**

**UNIT-II: DRUG DELIVERY SYSTEMS:**

Fundamentals of drug delivery: rationale of sustain/ control released (CR), Physicochemical and biological factors influencing design and performance of control released products. Polymers in CR: classification, properties, biocompatible and biodegradable polymers. Modeling of drug release from porous polymer: drug released from non porous and hydrophobic polymer. Diffusional release and dissolution controlled release from monolithic devices, micro porous systems. Oral controlled drug delivery systems, mucosal drug delivery system, ocular drug delivery systems, parenteral drug delivery systems, transdermal drug delivery systems.

**16 HOURS**

**UNIT-III: CURRENT GOOD MANUFACTURING PRACTICE:**

Introduction, requirements of Good manufacturing practice and quality management, guidelines to manufacturing practice for medicinal products, premises and equipments, documentation and production and quality control.

Process development: introduction, solid dosage forms and granulation and safety, plan for process development equipment, validation, batch records. Regulatory aspects of process development: in process test, validation of equipment and definition of batch size, packing

**16 HOURS**

**UNIT-IV: STABILITY AND PREFORMULATION STUDIES OF MEDICINAL PRODUCTS:**

**Chemical stability:** Hydrolysis, dehydration, oxidation, isomerization, racemization, copolymerization, photochemical reactions, factors affecting chemical stability.

**Physical stability:** volatility, change in the water content of solids, changes in the crystal properties, physical changes in emulsions and suspensions. Stability of medicines in pharmaceutical practice, ex- glyceroltrinitrate tablet.

**Preformulation studies:** factor affecting dissolution, diffusion-pH, pKa, pKw, particle size, solubility, etc. Methods to increase solubility of poorly soluble drugs, drug release mechanism. Factors affecting/necessitating preformulation of drug.

**16 HOURS**

M.Sc. III semester Pharmaceutical Chemistry  
Paper PCHC-3.2-(L)- Medicinal Chemistry-I

**UNIT-I: BASIC PRINCIPLES OF MEDICINAL CHEMISTRY AND DRUG DEVELOPMENT**

Basic consideration, historical evolution, fundamental aspects of drugs: forms, application, biological action, metabolism, drug interaction, adverse effects. Classification of drugs, nomenclature of drugs, drug combination. Selection of essential drugs. Physicochemical properties of drug molecules in relation to biological activity; solubility, partition coefficient, hydrogen bonding. Prodrugs and drug delivery system: utility of prodrugs, types of prodrugs, mechanism of drug activation- carrier linked prodrugs, carrier linkages for various functional groups, bioprecursor prodrug.

**16 HOURS**

**UNIT-II: SAR and QSAR**

History and development of QSAR. Designing of analogous drugs based on original lead. Bioisosteric replacements. Rigid analogs, ring size, alkyl chain branching, ring position, isomers etc. Alteration of stereochemistry and design of stereo and geometrical isomers, physical properties related to potency, calculation, measurements and meaning of partition coefficient. Hansch analysis and application, Craig's plot. Free Wilson analysis and application.

**16 HOURS**

**UNIT-III: SULPHONAMIDES, ANTI AMEBOIC AND ANTI-INFECTIVE AGENTS**

**Sulfonamides:** introduction, nomenclature, synergism of sulfonamides and folate reductase inhibitors, SAR studies and synthesis of Sulfisoxazole, sulfapyridine, sulfacetamide and sulfamethoxazole.

**Antiameobic agents:** introduction, classification. mechanism of action and synthesis of metronidazole, iodoquinol and dimercaprol.

**Local antiinfective agents:** introduction, classification, mechanism of action, synthesis and SAR of nitrofurazone and furazolidones.

**16HOURS**

**UNIT-IV: ANTIMALARIALS AND ANTIBIOTICS**

Etiology of malaria. Mechanism of action and SAR of Quinoline antimalarials. Synthesis of chloroquin, primaquin and quinacrine.

**Antineoplastic agents:** introduction, classification and mechanism of action of mustard gases and antimetabolites

**Anticonvulsant:** introduction, classification, mechanism of action, Synthesis and SAR of Phenyntoin sodium, carbamazepine.

**16HOURS**

### **Paper PCHC-3.3-(P) Medicinal chemistry practical**

Assays: Aspirin, paracetamol, analgin, ibuprofen, calcium gluconate, pheniramine maleate and chloroquin.

Synthesis: Benzimidazole, Coumarine derivative and Banzocain.

Books:

1. Introduction to quantitative drug design. Y C martin
2. Comprehensive medicinal chemistry. Crowin and Hansch
3. Medicinal chemistry- Burger
4. Principles of drug design. Smith
5. Principles of medicinal chemistry- willium o Foye
6. Drug design volumes- arienes
7. Strategies of drug design- Brucell
8. The organic chemistry of Drug design and drug action- Richard. B. Silvermann.
9. Fundamentals of medicinal chemistry-Ghareth Thomas. John wiley and sons UK

## M.Sc. III semester Pharmaceutical Chemistry

### Paper PCSC-3.3-(L)- Spectroscopy

#### **UNIT-I: UV-VISIBLE SPECTROSCOPY**

##### **Electromagnetic radiation**

Characterization – quantization of energy levels – regions of electromagnetic radiation spectrum – interaction electromagnetic radiation with matter – representation of spectra-intensity and width of spectral lines. **UV-Visible Spectroscopy:** Quantitative aspects of absorption – Beer- Lambert's law. Terminology associated with absorption measurements. Criteria for spectrophotometric determinations with examples (Fe, Mo and Ni). Limitations of the law, Types of absorption bands, modes of electronic transitions, simple chromophoric –auxochrome theory, solvent effect and choice of solvent. Prediction of  $\lambda$ -max value by using Wood-Ward and Fieser rules for conjugated dienes, trienes and cyclic  $\alpha$ ,  $\beta$  unsaturated aldehydes and ketones, Instrumentation (single beam and double beam spectrophotometers). Quantitative applications of UV-Visible spectroscopy in structural determination.

**16 HOURS**

#### **UNIT-II: IR- SPECTROSCOPY**

Nature of infrared radiation- wavelength, frequency and energy of IR radiation. Interaction of IR radiation with matter (organic molecules) and effect on covalent bonds. Modes of vibrations of covalent bonds. Fundamental vibrations and IR active vibrations. Hook's Law and calculation of vibrational frequency of various chemical bond. Various factors influencing IR absorption bands- vibration coupling, hydrogen bonding, electronic effects, bond angles and field effect. Instrumentation-IR spectrometer. Sampling techniques. Qualitative interpretation of IR spectra. Applications of IR spectroscopy in organic chemistry. Recent advances in IR spectroscopy including FT-IR, ATR etc.

**16 HOURS**

#### **UNIT-III: NMR SPECTROSCOPY**

Introduction, basic principles involved in NMR spectroscopy. Magnetic properties of nuclei, nuclear spin, nuclei as tiny bar magnets orientation of nuclei in a magnetic field. Precisional motion. Fundamental NMR equation. NMR Spectrometer. Mechanism of absorption of NMR radiation. Chemical shifts- mechanism of shielding and deshielding effects in alkanes, alkyl halides, alkenes aromatic, compounds and carbonyl compounds. Measurement of chemical shift and delta values. Spin-spin coupling relative intensities of peaks. Karplus equation-Curve. Equivalent and non equivalent protons. Factors influencing chemical shifts. Spin decoupling.

**16 HOURS**

#### **UNIT-IV: MASS SPECTROSCOPY**

Basic principles and brief outline of instrumentation. Ion formation and types-molecular ion, meta stable ions, fragmentation processes. Fragmentation patterns and fragmentation characteristics in relation to parent structure and functional groups. Molecular ion peak, meta stable ion peak, mass analyzers, Mc Lafferty rearrangement, Retro-Diels alder reaction, ortho effect, relative abundance of isotopes and their contribution to characteristic peaks. Mass spectrum, its characteristics. Presentation and interpretation-structural elucidation of some organic compounds,. Various ionization techniques-Chemical ionization mass spectrometry, Fast atom bombardment mass spectroscopy (FAB-MS). GCMS. Ion separation techniques Quadrupole mass spectrometer. Application of mass spectrometry in

quantitative and qualitative analysis. Determination of molecular formula and molecular weight. in quantitative and qualitative analysis. Determination of molecular formula and molecular weight.

**16 HOURS**

M.Sc. III semester Pharmaceutical Chemistry  
Paper PCOE-3.7:- Drugs and drug regulations

**UNIT-I: ANTIMALARIALS AND ANTIBIOTICS**

Etiology of malaria. Mechanism of action and SAR of Quinoline antimalarials. Synthesis of chloroquin, primaquin and quinacrine.

**Antineoplastic agents:** introduction, classification and mechanism of action of mustard gases and antimetabolites

**Anticonvulsant:** introduction, classification, mechanism of action, Synthesis and SAR of Phenyntoin sodium, carbamazepine.

**16HOURS**

**UNIT-II: DRUG DELIVERY SYSTEMS:**

Fundamentals of drug delivery: rationale of sustain/ control released (CR), Physicochemical and biological factors influencing design and performance of control released products. Polymers in CR: classification, properties, biocompatible and biodegradable polymers. Modeling of drug release from porous polymer: drug released from non porous and hydrophobic polymer. Diffusional release and dissolution controlled release from monolithic devices, micro porous systems. Oral controlled drug delivery systems, mucosal drug delivery system, ocular drug delivery systems, parenteral drug delivery systems, transdermal drug delivery systems.

**16 HOURS**

**UNIT-III: CURRENT GOOD MANUFACTURING PRACTICE:**

Introduction, requirements of Good manufacturing practice and quality management, guidelines to manufacturing practice for medicinal products, premises and equipments, documentation and production and quality control.

Process development: introduction, solid dosage forms and granulation and safety, plan for process development equipment, validation, batch records. Regulatory aspects of process development: in process test, validation of equipment and definition of batch size, packing

**16 HOURS**

**UNIT-IV: STABILITY AND PREFORMULATION STUDIES OF MEDICINAL PRODUCTS:**

**Chemical stability:** Hydrolysis, dehydration, oxidation, isomerization, racemization, ppolymerization, photochemical reactions, factors affecting chemical stability.

**Physical stability:** volatility, change in the water content of solids, changes in the crystal properties, physical changes in emulsions and suspensions. Stability of medicines in pharmaceutical practice, ex- glyceroltrinitrate tablet.

**Preformulation studies:** factor affecting dissolution, diffusion-pH, pKa, pKw, particle size, solubility, etc. Methods to increase solubility of poorly soluble drugs, drug release mechanism. Factors affecting/necessitating preformulation of drug.

**M.Sc. IV semester Pharmaceutical Chemistry**  
**Paper PCHC-4.1-(L)- Basics of Pharmacology and Pharmaceutics**

**UNIT-I: GENERAL PHARMACOLOGY:**

Introduction, definition/sources and active ingredients of drugs, routes of administration of drugs, absorption of drugs and factors affecting them. Drug distribution, biotransformation and excretion. Mechanism of drug action, drug receptor interaction. Molecular and biochemical basis of drug action. Additive effects, synergism, potentiation. Factors modifying effects, drug toxicity, drug response relationship, structure activity relationship, drug interaction basic concepts of drug interactions (both *in vitro* and *in vivo*), preclinical and clinical evaluations.

**16 HOURS****UNIT-II: PHARMACOKINETICS:**

Absorption, distribution, elimination, dissolution of drugs and factors affecting these properties, passage of drugs across biological membrane, construction of diffusion equation for complex systems. Pharmacokinetics of one component and two component models. Some applications of pharmacokinetics. Principles of multidrugs, dose adjustment and availability, drug interactions illustrate with examples.

**16 HOURS****UNIT-III: SCREENING METHODS:**

General principles of screening of drugs, general screening methods, clinical trial. Experimental animals used in pharmacological assays *in vitro* *in vivo* studies. Tissue experiments and whole animal experiments. Bioassay, scope, principles involved and general methods. Bioassay of Acetylcholine, insulin and atropine. Screening method for evaluation of analgesic, anti-inflammatory, antiulcer, anticonvulsant, hepatoprotective, antidiabetic and natifertility activities. Methodology for microbial assay of penicillin, myconazole. Enzyme inhibition of acetylcholinesterase activity in rat stratum, COX inhibition studies.

**16 HOURS****UNIT-IV: PHARMACEUTICAL TECHNOLOGY:**

Introduction of pharmaceutical industrial processing. Extraction-methods of extraction, continuous extraction. Distillation-Theory of distillation, methods of distillation, azeotropic and steam extractive distillation. Drying- classification and types of dryers, factors affecting drying, tray dryer, fluidized bed dryer, freeze dryer, spray dryer

**16 HOURS**

M.Sc. IV semester Pharmaceutical Chemistry  
Paper PCHC-4.2-(L)- Medicinal chemistry-II

**Unit-I: CNS DEPRESSANT**

Classification, mechanism of action of following class of drugs.

- A) general anesthetics- synthesis of halothane, methoxyflurane and methohexital Sodium.
- B) Sedatives and hypnotics- Synthesis of chlorodiazepoxide, Diazepam and Phenobarbital.
- C) Anticonvulsants- Synthesis of Phenytoin sodium, Trimethadione and carbamazepine.

**16 HOURS**

**Unit-II: CARDIOVASCULAR AGENTS**

A) Antianginal and vasodilator-introduction, mechanism of action. B) Antiarrhythmic agents-introduction, mechanism of action synthesis of Verapamil. C) antihypertensive agents-introduction, mechanism of action synthesis of clonidine and hydropazine derivatives. D) hypo-hyper glycaemic agent-introduction, mechanism of action, synthesis of tolbutamide and tolazamide.

**16 HOURS**

**Unit-III: ANALGESIC, ANTIHISTAMINIC AND ANTI-INFLAMMATORY AGENTS**

Narcotic and non narcotic agents- introduction, mechanism of action, synthesis of Ibuprofen, acetaminophen, phenylbutazone. Mechanism of action of antihistaminic agents, synthesis of diphenhydramine hydrochloride, pyrrolamine, Pheniramine.

**16 HOURS**

**Unit-IV: ANTITUBERCULAR, ANTILEPTICS AND ORAL CONTRACEPTIVES**

Introduction, classification and mechanism of action. Synthesis of isoniazide, ethambutol, clofazimine and dapsone.

Classification, mechanism of action of oral contraceptives. Synthesis of any two non steroidal oral contraceptives.

Antineoplastics- introduction, classification and mechanism of action of mustard gas and anti metabolites

**16 HOURS**



M.Sc. IV semester Pharmaceutical Chemistry syllabus  
PAPER:- PCSC-4.3:(L)-Bioorganic chemistry

**UNIT-I: CARBOHYDRATES:**

Introduction, nomenclature, classification, chemical properties of aldoses and ketoses. Mutarotation, formation and hydrolysis of glycosides. Action of alkalis: reverse aldol reaction, Lobry-Brounvan-Emkenstein rearrangement. Action of acids on monosaccharides, methylation, esterification, reduction, oxidation. Reaction of monosaccharides. Kiliani Fischer synthesis (step-up reaction). Wohl and Ruff degradation (step-down reaction), epimerization, conversion of aldose to ketose and vice-versa. Disaccharides, polysaccharides, Hudson's rules, periodic effect.

**16 HOURS**

**UNIT-II: AMINOACIDS AND PEPTIDES:**

**Amino acids:** introduction, classification, isoelectric point. Synthesis of amino acids: Strecker's synthesis, Gabriel phthalimide synthesis. Ehrlich-Meyer's synthesis, Knoop synthesis. Chemical reactions of  $\alpha$ -amino acids: reactions involving a) amino group, b) carboxylic acid group, c) carboxylic acid amino group.

**Peptides:** introduction, peptide linkage, major methods of peptide synthesis: synthesis of following di and tripeptides by using Merrifield resin a) gly-gly b) gly-ala, c) lgy-val, d) gly-gly-gly, e) gly-al-al, f) al-al-gly. Stereochemical features and conformational features. Determination of primary structure of proteins. Blocking agents and deblocking agents used in amino group protection and deprotection. Reagents and reaction used in activation of carboxylic group of amino protected amino acids. Synthesis in solution: selective protection of the  $\alpha$ -amino group,  $\alpha$ -carbonyl group, trifunctional amino acids

**16 HOURS**

**UNIT-III: LIPIDS:**

Nomenclature, classification purification, structure and synthesis of lipids, phospholipids, sphingolipids. Biological importance of lipids: lecithin, sphingolipids, oils and fats, lipid metabolism: introduction,  $\beta$ -oxidation of saturated (palmitic acid) and unsaturated fatty acids (linolenic acid). Cholesterol, metabolism, formation and fate of keto bodies.

**16 HOURS**

**UNIT-IV: ENZYMES:**

Classification, characteristics of enzymes, enzyme substrate complex. Concept of active centre, binding sites, stereo specificity and ES complex formation. Effect of temperature, pH and Substrate concentration on reaction rate. Activation energy. Transition state theory. Enzyme kinetics: Michaelis-Menten equation- form and derivation, steady state enzyme kinetics. Significance of  $V_{max}$  and  $K_m$ . bisubstrate reactions. Graphical procedures in enzymology-advantages and disadvantages of alternate plotting. Enzyme inhibition-types of inhibitors-competitive noncompetitive and uncompetitive, their mode of action and experimental determination. Enzyme catalysis: factors affecting catalytic efficiency-proximity and orientation effects, distortion of strain, acid base and nucleophilic catalysis.

**16 HOURS**

M.Sc. III semester Pharmaceutical Chemistry  
Paper PCOE-4.7(L)- Pharmacology and Therapeutic Agents

**Unit-I: GENERAL PHARMACOLOGY:**

Introduction, definition/sources and active ingredients of drugs, routes of administration of drugs, absorption of drugs and factors affecting them. Drug distribution, biotransformation and excretion. Mechanism of drug action, drug receptor interaction. Molecular and biochemical basis of drug action. Additive effects, synergism, potentiation. Factors modifying effects, drug toxicity, drug response relationship, structure activity relationship, drug interaction basic concepts of drug interactions (both in vitro and in vivo), preclinical and clinical evaluations.

**16 HOURS**

**Unit-II: PHARMACOKINETICS:**

Absorption, distribution, elimination, dissolution of drugs and factors affecting these properties, passage of drugs across biological membrane, construction of diffusion equation for complex systems. Pharmacokinetics of one component and two component models. Some applications of pharmacokinetics. Principles of multidrugs, dose adjustment and availability, drug interactions illustrate with examples.

**16 HOURS**

**UNIT-III: ANTITUBERCULAR, ANTILEPTOTICS AND ORAL CONTRACEPTIVES**

Introduction, classification and mechanism of action. Synthesis of isoniazide, ethambutol, chlofazimine and dapson.

Classification, mechanism of action of oral contraceptives. Synthesis of any two non steroidal oral contraceptives.

Antineoplastics- introduction, classification and mechanism of action of mustard gas and anti metabolites

**16 HOURS**

**UNIT-IV: CARDIOVASCULAR AGENTS**

A) Antianginal and vasodilator-introduction, mechanism of action. B) Antiarrhythmic agents-introduction, mechanism of action synthesis of Verapamil. C) antihypertensive agents-introduction, mechanism of action synthesis of clonidine and hydropazine derivatives. D) hypo-hyper glycaemic agent-introduction, mechanism of action, synthesis of tolbutamide and tolazamide.

**16 HOURS**

M.Sc. IV semester Pharmaceutical Chemistry  
Paper PCHCP-4.8:- Major project

Candidates are expected to work on assigned research project and submit the result at the end of the semester in the form of a dissertation which will be for 8 credits. Project work involving multistage synthesis or isolation of active molecules present in medicinal plants or pharmacokinetic studies or evaluation of biological activities

BOOKS:

1. Comprehensive medicinal chemistry- corwin and Hansch
2. Medicinal chemistry-Burgers (Vol-I-VI)
3. Principles of medicinal chemistry-William O Foye
4. Text book of medicinal chemistry- vol-I&II- Surendra N Pandey
5. Principles of medicinal chemistry- S S Kadam, K R Mahadika and K G Bothara
6. Introductory medicinal chemistry- Kennewell and Taylor
7. Wilson and Giswold's Twext book of Organic medicinal and Pharmaceutical chemistry- Jaimes N Delgado and William A Remere
8. Fundamentals of microbiology- Forpischer
9. Genetics of antibiotics producing microorganisms- G Sermouti
10. Principles of industrial microbiology- A. Rhodes and D L Fletcher
11. Industrial Pharmcey-Lachman
12. Industrial fermentation- Koflu and Hickey
13. Rhemingtons Pharmaceutical sciences, Vol-I and II- A Osol
14. Bentley`s textbook of pharmaceutics- P A Rowling
15. Pharmcological basics of therapeutics-Goodman and Gillman
16. Pharmacology and pharmacotherapeutics- R S satosker and S D Bhandarkar
17. Biopharmaceutics and Pharmacokinetics- G R Chatwal

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