

Mahatma Gandhi University, Nalgonda
DEPARTMENT OF CHEMISTRY & PHARMACEUTICAL SCIENCES
M.Sc.5Yr Integrated Pharmaceutical Chemistry CBCS Syllabus
(Effective from academic year 2015-2016 for Campus college)
[UNDER RESTRUCTURED CBCS Scheme]
(Revised in the P.G. BOS meeting held on 21-07-17)

Scheme of teaching & examination:

Semester-I

S.No	Subject	Paper (Theory)	Teaching hrs/week	Examination hrs	Internal marks	Final Exam marks	Total marks	Credits
1.	English (E101)	P-I	5	3	10	40	50	5
2.	Telugu (T 102) Or Sanskrit(S 102)	P-I	5	3	10	40	50	5
3.	Chemistry (CH103)	P-I	4	3	10	40	50	4
4.	Pharmaceutical Chemistry P.CH(104)	P-I	4	3	10	40	50	4
5.	Maths for BYPC(M105) Biology for MPC I (B105)	P-I P-I	4 4	3 3	10 10	40 40	50 / 50	4
6.	Environmental science (noncore) (N106)	NC-I	2	3	10	40	50	2
		Practical classes						
1.	Chemistry (CH 151)	P-I	3	3	--	25	25	2
2.	Pharmaceutical Chemistry (P.CH 152)	P-I	3	3	--	25	25	2
3.	Maths(M153) / Biology(B153)	P-I P-I	3 3	3 3	--	25	25	2
Total							375	30

Semester-I

Optional I: Chemistry:

Paper-I : Chemistry (Chem 103)

U-1. Inorganic Chemistry

U-2 Organic Chemistry

U-3 Physical Chemistry

U- 4 General Chemistry

U-1. (Inorganic Chemistry)

15hr

1.1: Periodic Properties

3 hours

Review of trends in atomic and ionic radii- covalent radii- single, double and triple bond, Vander waal radii, radii of cations and anions, isoelectronic ions. Ionization energy, electropositivity, basic nature, reducing behaviour. Electronic affinity, electronegativity – Methods of determination and evaluation – Paulings and Mulliken's approach application in predicting and explaining chemical behaviour- nature of bond, bond length and bond angles, diagonal relationship.

1.2 s-block elements

3 hours

General characteristics of groups I & II elements, diagonal relationship between Li & Mg, Be & Al.

1.3 p-block elements -I

9 hours

General characteristics of elements of groups 13, 14, 15, 16 and 17

Group – 13: Synthesis and structure of diborane and higher boranes (B_4H_{10} and B_5H_9), boron-nitrogen compounds ($B_3N_3H_6$ and BN)

Group – 14: Preparation and applications of silanes and silicones, graphitic compounds.

U-2(Organic Chemistry)

15hr

2.1: Structural Theory in Organic Chemistry

8 hr

Brief review of structural theory of organic chemistry, Hybridization, Bond length, bond angle, bond energy, curved arrow notation, drawing electron movements with half headed and double headed arrow. Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents including neutral molecules like H_2O , BF_3 , NH_3 & $AlCl_3$).

Bond polarization: Factors influencing the polarization of covalent bonds, electro negativity – inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol. (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes.

Types of organic reactions: Addition - electrophilic, nucleophilic and free radical. Substitution – electrophilic, nucleophilic and free radical. Elimination – Examples.

2.2: Acyclic Hydrocarbons

7hr

Alkanes –IUPAC Nomenclature of Hydrocarbons. Methods of preparation: Hydrogenation of alkynes and alkenes, Wurtz reaction, Kolbe’s electrolysis, Corey-House reaction. Chemical reactivity - inert nature, free radical substitution mechanism. Halogenation example- reactivity, selectivity and orientation.

Alkenes - Preparation of alkenes (a) by dehydration of alcohols (b) dehydrohalogenation of alkyl halides (c) by dehalogenation of 1,2 dihalides (brief mechanism), Zaitsev’s rule. Properties: Addition of Hydrogen – heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov’s rule, addition of H₂O, HOX, H₂SO₄ with mechanism and addition of HBr in the presence of peroxide (anti – Markonikov’s addition). Oxidation – by KMnO₄, OsO₄, Peracids, hydroboration, ozonolysis – location of double bond. Dienes – Types of dienes, reactions of conjugated dienes – 1,2 and 1,4 addition of HBr to 1,3 – butadiene and Diel’s – Alder reaction.

Alkynes – Preparation by dehydrohalogenation of dihalides, dehalogenation of tetrahalides, acetylene from CaC₂. Properties: Acidity of acetylenic hydrogen (Formation of metal acetylides) preparation of higher acetylenes, metal-ammonia reductions. Physical properties. Chemical reactivity – electrophilic addition of X₂, HX, H₂O (tautomerism), Oxidation (formation of enediol, 1,2 diones and carboxylic acids), reduction and polymerization reaction of acetylene.

U-3 (Physical Chemistry)

15 hr

3.1: Gaseous State

7 hours

Deviation of real gases from ideal behaviour. Vander Waals equation of state. Critical phenomenon. PV isotherms of real gases, continuity of state. Andrew’s isotherms of CO₂. The Vander Waal’s equation and critical state. Derivation of relationship between critical constants and van der Waal’s constants. Experimental determination of critical constants. The law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Liquefaction of gases: i) Linde’s Method based on Joule Thomson effect ii) Claude’s Method based on Adiabatic expansion of a gas.

3.2: Liquid State**3 hours**

Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Liquid crystals, the mesomorphic state: Classification of liquid crystals into Smectic and Nematic, differences between liquid crystal and solid / liquid. Application of liquid crystals as LCD devices, lubricants and indigestion/assimilation of food.

3.3 Solutions**5 hours**

Liquid-liquid - ideal solutions, Raoult's law. Ideally dilute solutions, Henry's law. Non-ideal solutions. Vapour pressure – composition and vapour pressure-temperature curves. Azeotropes-HCl-H₂O, ethanol-water systems and fractional distillation. Partially miscible liquids-phenol-water, trimethylamine-water, nicotine-water systems. Effect of impurity on consolute temperature. Immiscible liquids and steam distillation. Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

U-4 (General Chemistry)**4.1: Atomic Structure and Elementary Quantum Mechanics****7 hours**

Blackbody radiation, Planck's radiation law, photoelectric effect, Compton effect, de Broglie's hypothesis, Heisenberg's uncertainty principle. Postulates of quantum mechanics. Schrodinger wave equation and a particle in a box, energy levels, wave functions and probability densities. Schrodinger wave equation for H-atom. Separation of variables, Radial and angular functions, hydrogen like wave functions, quantum numbers and their importance.

4.2: Theory of Quantitative Analysis**5 hours**

Principle of Volumetric Analysis- introduction, standard solutions, indicators, end point, titration curves, Types of titrations: i) neutralization titration- principle, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid- strong base and weak acid –weak base.

ii) Redox titrations- principle, detection of end point, redox indicators. iii) Precipitation titrations, principle, detection of end point, indicators. iv) Complexation titrations- principle, metal ion indicators.

Principle of Gravimetric analysis- nucleation, precipitation, growth of precipitate, filtration and washing, drying and incineration of precipitate, coprecipitation and post precipitation.

4.3: Evaluation of analytical data.**3 h**

Theory of errors, idea of significant figures and its importance, accuracy – methods of expressing accuracy, error analysis and minimization of errors, precision – methods of expressing precision, standard deviation and confidence limit.

References :

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001. Chem.
4. Vogel's Qualitative Inorganic Analysis by Svehla
5. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn.
6. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
7. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.
8. Qualitative analysis by Welcher and Hahn.

Unit- II

1. Text book of organic chemistry by Morrison and Boyd.
2. Text book of organic chemistry by Graham Solomons.
3. Text book of organic chemistry by Bruice Yuranis Powla.
4. Text book of organic chemistry by Soni.
5. General Organic chemistry by Sachin Kumar Ghosh.

Unit III

1. Principles of physical chemistry by Prutton and Marron.
2. Text Book of Physical Chemistry by Soni and Dharmahara..
3. Text Book of Physical Chemistry by Puri and Sharma.
4. Text Book of Physical Chemistry by K. L. Kapoor.
5. Physical Chemistry through problems by S.K. Dogra.
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry by Lewis Glasstone.

Unit IV

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001. Chem

Laboratory Course:

Paper- I:Chemistry (Chem 151)

I. Calibration of weights and Glassware

II. Titrimetric analysis:

Acid - Base titrations

1. Estimation of Carbonate in Washing Soda.
2. Estimation of Bicarbonate in Baking Soda.
3. Estimation of Carbonate and Bicarbonate in the Mixture.
4. Estimation of Alkali content in Antacid using HCl.
5. Estimation of acetic acid in Commercial Vinegar using NaOH.
6. Estimation of Ammonium ion.

III Gravimetry:

1. Estimation of Barium as Barium Sulphate
2. Estimation of Nickel as Nickel dimethylglyoxinate
3. Determination of lead as lead chromate

Optional-II: Pharmaceutical Chemistry

Paper-I Basics of Pharmaceutical Chemistry (P.CH.104)

U-1: Introduction to Drugs & Pharmaceuticals: 15hrs

Introduction: Origin, development and scope of chemical sciences, pharmaceutical sciences, introduction to the fundamentals of pharmaceutical sciences, Drug and disease (definition). Historical evolution. Sources-plant, Animal and synthetic Biotechnology and human gene therapy. Terminology: Pharmacy, pharmacology, pharmacophore, pharmacodynamics, Pharmacokinetic- (ADME, Receptors- brief treatment), Metabolites and Anti-metabolites. Nomenclature: Chemical name, Generic name, and Trade names with examples. Classification: Classification based on structures and therapeutic activity with one example each.

U-2: Formulations, Properties & their influence: 15hrs

Introduction: Need of conversion of drugs into medicine. Classification: Classification of formulations-(form wise, dose wise) with example.

Additive and their role.

classification and uses of following additives in formulation of different dosage forms: preservatives, antioxidants, surfactants, hydrocolloids, emulsifying agents, suspending agents, diluents, binders, lubricants, and organoleptic additives.

Physical, chemical and biological properties of drug molecules and their influence on drug formulation.

U-3: Impurities & sources of impurities in drug formulations 15hrs

Purity-Broad based highest attainable standard, Biological response VS. Chemical purity and Official standard VIS-VIS manufacturing standards. Specific tests for identifying impurities- egs. Presence of salicylic acid in Aspirin, 4- aminophenol in Paracetamol, (+)-2-amino-Butan-1-ol in Ethambutol Hydrochloride, Digitonin in Digitoxin etc.

Limit tests: Introduction, specificity, sensitivity and Personal errors. Types of limit tests for quantitative determination- Limit for insoluble matter, limits for soluble matter, limits for moisture, volatile matter and residual solvents.

Limit tests for Acid radical impurities: For Chlorides, Sulphates, Arsenate, carbonate, Cyanide, Nitrate, Oxalate and Phosphate.

U-4: Development of Pharmaceuticals

Introduction to Pharmacopoeias - IP, BP, USP & International Pharmacopoeia, National Formularies and Extra Pharmacopoeia. Typical parts of a monograph of Indian pharmacopoeia with examples, quality control and quality assurance, introduction to GLP, GMP, Laboratory

Accreditation, quality estimation of aspirin, acetaminophen, isoniazid, ascorbic acid, codeine phosphate, Chloride in Ringers lactate, ethambutol.

Recommended Text Books:

1. Pharmaceutical Drug analysis by Ashtoshkar
2. Pharmaceutical Chemistry by Chatwal.
3. Drugs by David Subramanyam.
4. British Pharmacopoeia vol I,II
5. Indian Pharmacopoeia vol I,II
6. Bentley's Text book of pharmaceutics by Rowlinson
7. The science and practice of pharmacy by Remington
8. Introduction to pharmaceuticals by Mittal

Lab:

Practical Paper-I (P.CH 152) :Identification of impurities in formulations and Limit tests

Specific tests for Impurities present in Pharmaceutical substances:

1. Preparation and dilution of solutions
2. Weighing of solid, liquid substances
3. Weight variation analysis of tablets.
4. Preparation of neutral, acidic and basic phosphate buffers
5. Presence of salicylic acid in Aspirin
6. 4- amino phenol in Paracetamol
7. (+)-2-amino-Butane-1-ol in Ethambutol Hydrochloride
8. Chlorophenol in Chlorophensin
9. Digitonin in Digitoxin
10. Monograph analysis of paracetamol tablets
11. Limit tests for Acid radical impurities:
Chlorides, Sulphates, Arsenate, Carbonate, Cyanide, Nitrate, Oxalate and Phosphate.

Recommended Text Books:

1. Practical pharmaceutical chemistry Part I by Beckett & Stenlake
2. Pharmaceutical Drug analysis by Ashtoshkar

Optional III: MATHEMATICS / BIOLOGY

Paper-I MATHEMATICS: (for Biology students) (M105)

U – 1: Logarithms & Trigonometry

U – 2: Differential & Integral Calculus

U– 3: Matrices

U-4: Statistics

U – 1: Logarithms & Trigonometry **15Hrs**

Logarithms: Logarithm of a real number to an arbitrary base, Napier ion Base – Theorems on Logarithms – Use of Tables.

Trigonometry: Measurement of angles, Trigonometrical ratios and simple relations connecting the complimentary and supplementary angles, Negative angles sum and difference of two angles, sine and cosine formulae for multiple angles and half angles.

U – 2: Differential & Integral Calculus **15Hrs**

Differential Calculus: Functions, Limits, Differential coefficient rules, Differentiation of a sum, product and quotient of functions, Differentiation from first principles, Differentiation of implicit, Geometrical, composite and inverse functions, Partial Differentiation, Maxima and Minima.

Integral Calculus: Integration considered as converse of differentiation, simple integrations, standard forms like $x dx$, $\sin(ax) dx$, $\cos(ax) dx$, $\sec(ax) dx$ etc. Methods of substitution, simple example integration by parts. Integration of rational, irrational, trigonometrical functions. Calculations of areas of standard bodies using integration.

U– 3: Matrices **15Hrs**

Matrices: Matrices, basic definitions, matrix operations, transpose, adjoint, rank, inverse of a matrix, solution of linear systems of equations- LU decomposition, matrix inversion, Gaussian elimination.

U-4: Statistics **15Hrs**

Statistics: Mean, Median, Mode, relation between mean, median, and mode. Standard deviation, histogram, Coefficient of correlation, regression analysis, curve fitting, T-Test, Chi-Square Test, analysis of variance, theory of probability.

Text Books:

1. A text book of Mathematics by N.Krishna Murthy, Chand series, Volume- I and II
2. Fundamentals of statistics by D.N. Elhance, Veena Elhance & B.M.Agarwal.
3. Higher Engineering Mathematics by Grewal

OPTIONAL-III: MATHEMATICS/BIOLOGY

Paper-I BIOLOGY (for MPC students) (B105)

U-1: Origin of life , Diversity of living organisms and classification 15 Hrs

- 1.1 History onto study of the origin of life
- 1.2 Spontaneous evolution, Darwin theory
- 1.3 Current models of Origin of organic molecules
- 1.4 Urey and miller`s experiment, Fox experiments
- 1.5 Concept of species and taxonomical hierarchy; Binomial nomenclature
- 1.6 Three domain of classification of living organisms
- 1.7 Five kingdom classification; Salient features and classification of Monera; Protista Fungi, Plantae and Animalia (Brief)

U-2. – Cell theories and Cell Structure 15 Hrs

- 2.1.Discovery of cells
- 2.2.Cell theories: Theodor Schwann and Matthias Jakob Schleiden.
- 2.3.Cells as basic units of living organisms
- 2.4.Ultra structure of Virus and classification
- 2.5.Ultra structure of fungal, plant cells
- 2.6.Ultra structure of prokaryotic cell and eukaryotic cell

U-3 Structural organization and Division of Cell 15 Hrs

- 3.1. Organelles of Plant and animal cells
- 3.2. Mitochondria,
- 3.3.Chloroplast
- 3.4. Endoplasmic reticulum,
- 3.5.Golgi apparatus,
- 3.6..Lysosomes and vacuoles.
- 3.7.Cell Cycle and Regulation
- 3.8.Different stages of Mitosis and its significance
- 3.9.Different stages of Meiosis and its significance

U-4 Morphology and Life History of Human Parasites: 15Hrs

Plasmodium, Entamoeba, tapewarm, ascaris, leishmania, anchylostoma and trypanosoma. Life history of Mosquitoes and housefly as agents for spreading diseases.

Reference Books:

1. Text Book Of Organic Evolution- by Arora M P
2. A text book of botany, by A.C. Dutta
3. A text book of biology by Vikram series
4. Cell and Molecular Biology - By De Robertis
5. Cell and Molecular Biology - By Lodish
6. Cell Biology and Genetics - By P.K. Gupta

Paper-I: Biology (B153) (for MPC students)

1. Introduction of Microscope and their handling.
2. Morphology of various Plant parts.
3. Histological study of (Transverse sections)
 - a) Monocot Root
 - b) Monocot stem
 - c) Monocot Leaf
 - d) Dicot Root
 - e) Dicot Stem
 - f) Dicot Leaf
4. Preparation of different stages of Mitosis
5. Preparation of different stages of Meiosis
6. Histology of Organs and tissues (Permanent slides)
 - a) Digestive system
 - b) Respiratory system
 - c) Circulatory system
 - d) Reproductive system
7. Microscopic examination of Parasites of Biological importance (Permanent slides)
 - a) Plasmodium
 - b) Entamoeba
 - c) Tapeworm
 - d) Ascaris
 - e) Leishmania
 - f) Trypanosoma

(Noncore) (N106) Environmental science

U – 1: The Multidisciplinary nature of environmental studies:

U – 2: Ecosystems

U-3: Biodiversity and its conservation

U-4: Environmental Pollution

U – 1: The Multidisciplinary nature of environmental studies:

Definition, Scope and Importance.

Natural Resources:

- a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.
- c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- e) Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies.
- f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

U – 2: Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Producers, Consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem :

a) Forest ecosystem b) Grassland ecosystem, c) Desert ecosystem, d) Aquatic ecosystems (Ponds, streams, lakes, rivers, oceans, estuaries)

U-3: Biodiversity and its conservation

Introduction – Definition: genetic, species and ecosystem diversity.

Biogeographically, classification of India. Value of biodiversity: consumptive use, productive use, and social, ethical, aesthetic and option values, Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ conservation of biodiversity.

U-4: Environmental Pollution

Definition, causes, effects and control measures of :

a) Air pollution, b) Water pollution, c) Soil pollution, d) Marine pollution, e) Noise pollution, f) Thermal pollution and g) Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Disaster management: floods, earthquake, cyclone and landslides.

References:

1. Environmental Studies by Kaushik and Kaushik.
2. Environmental Science by Erach Bharucha.

**Scheme of teaching & examination:
Semester-II**

S.No	Subject	Paper	Teaching hrs/week (Theory)	Examination hrs	Internal marks	Final Exam marks	Total marks	credits
1.	English (E 201)	P-II	5hr	3	10	40	50	5
2.	Telugu (T 202) or Sanskrit(S202)	P-II	5	3	10	40	50	5
3.	Chemistry (CH.203)	P-II	4	3	10	40	50	4
4.	Pharmaceutical Chemistry (P.CH 204)	P-II	4	3	10	40	50	4
5.	Biotechnology (BT.205)	P-I	4	3 3	10 10	40 40	50	4
6.	Computer skills (C206) (noncore)	NC-II	2	3	10	40	50	2
		Practical classes						
1.	Chemistry (CH.251)	P-II	3	3	--	25	25	2
2.	Pharmaceutical Chemistry (P.CH252)	P-II	3	3	--	25	25	2
3.	Biotechnology (BT.253)	P-I	3	3	--	25	25	2
total							375	30

Semester-II

Optional-I Chemistry

Paper-II Chemistry (CH 203)

U-1. Inorganic Chemistry

U-2 Organic Chemistry

U-3 Physical Chemistry

U- 4 General Chemistry

U-1 (Inorganic Chemistry)

15hr

1.1 p-block Elements -II

8 hours

Comparative study of Group 13-17

Group – 15: Preparation and reactions of hydrazine, hydroxylamine, phosphazenes.

Group – 16: Classifications of oxides based on (i) Chemical behaviour and (ii) Oxygen content.

Group – 17: Inter halogen compounds and pseudo halogens

1.2: Organometallic Chemistry

7 h

Definition and classification of organometallic compounds, nomenclature, preparation, properties and applications of alkyls of 1, 2 and 13 group elements.

U -2 (Organic chemistry)

15 hr

2.1: Alicyclic Hydrocarbons (Cycloalkanes)

4 hours

Nomenclature, Preparation by Freund's methods, heating dicarboxylic metal salts. properties – reactivity of cyclopropane and cyclobutane by comparing with alkanes. Stability of cycloalkanes – Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane.

2.2: Benzene and its Reactivity

8 hours

Concept of Resonance and resonance energy. Concept of aromaticity – aromaticity (definition), Huckel's rule – application to Benzenoid (Benzene, Naphthalene, Anthracene and

Phenanthracene) and Non – Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation).

Reactions - General mechanism of electrophilic substitution, mechanism of nitration, sulfonation and halogenation, Friedel Craft's alkylation and acylation.

Orientation of aromatic substitution - Definition of ortho, para, and meta directing groups. Ring activating and deactivating groups with examples. (Electronic interpretation of various groups like NO₂ and Phenolic). Orientation: i. Amino, methoxy and methyl groups. ii. Carboxy, nitro, nitrile, carbonyl and sulfonic acid groups. iii. Halogens (Explanation by taking minimum of one example from each type).

2.3: Arenes and Polynuclear Aromatic Hydrocarbons

3 hours

Preparation of alkyl benzenes by Friedel Craft's alkylation, Friedel Craft's acylation followed by reduction, Wurtz-Fittig reaction. Nuclear substitution reactions, side chain substitution reactions and oxidation.

Polynuclear hydrocarbons – Structure of naphthalene and anthracene (Molecular Orbital diagram and resonance energy) Reactivity towards electrophilic substitution. Nitration and sulfonation as examples.

U-3 (Physical Chemistry)

15 hr

3.1 Solid State

6 hours

Laws of Crystallography – (i) Law of Constancy of interfacial angles (ii) Law of Symmetry, Symmetry elements in crystals (iii) Law of rationality of indices. Definition of space lattice, unit cell. Bravais Lattices and Seven Crystal systems. X-ray diffraction by crystals; Derivation of Bragg's equation, Determination of structure of NaCl (Bragg's method and Powder method). Defects in crystal: Stoichiometric and Non stoichiometric defects. Band theory of Semiconductors: Extrinsic and intrinsic semiconductors, n-type and p-type and their applications in photo-electro chemical cells.

3.2 Colloids and Surface Chemistry

9 hours

Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties. Kinetic, Optical and Electrical stability of colloids, Protective action. Hardy-Schultz law, Gold number. Liquids in liquids(emulsions): Types of emulsions, preparation and emulsifier. Liquids in solids(gels); Classification, preparations and properties, inhibition, general applications of colloids.

Adsorption:Types of adsorption, Factors influencing adsorption. Freundlich adsorption isotherm. Langmuir theory of unilayer adsorption isotherm. Applications.

U-4 (General Chemistry)

15 hr

4.1 Chemical Bonding

11 hours

Ionic solids- lattice and solvation energy, solubility of ionic solids, Fajan's rule, polarity and polarizability of ions, covalent nature of ionic bond, covalent bond, stereochemistry of inorganic molecules. Common hybridization and shapes of molecules.

Molecular orbital theory: Shapes and sign convention of atomic orbitals. Modes of overlapping. Concept of σ and π bonds. Criteria for orbital overlap. LCAO concept. Types of molecular orbitals- bonding, antibonding and non bonding. Electron distribution diagram for H_2 , MOED of homonuclear diatomic molecules - H_2 , N_2 , O_2 , O_2^- , O_2^{2-} , F_2 and their ions (unhybridized diagrams only) and heteronuclear diatomic molecules CO, CN, NO, NO^+ and HF. Bond order and magnetic properties.

4.2 General Principles of Inorganic qualitative analysis

4 h

Solubility product, common ion effect, characteristic reactions of anions, elimination of interfering anions, separation of cations into groups, group reagents, testing of cations

Laboratory Course :

Paper II Chemistry (Chem 251)

I Redox titrations

- 1) Permanganometry: Determination of Fe(II) using $KMnO_4$ with oxalic acid as primary standard.
- 2) Dichrometry: Determination of Fe(II) using $K_2Cr_2O_7$
- 3) Determination of Cu(II) using $Na_2S_2O_3$ with $K_2Cr_2O_7$ as primary standard
- 4) II Precipitation titrations: Estimation of Zinc ion by Ferrocyanide.

III Complexometry

- 1) Determination of Magnesium ion in Talcum powder.
- 2) Determination of Zinc using EDTA
- 3) Determination of hardness of water

References

Unit I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn
4. Wiley Publishers 2001. Chem
5. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
6. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.
7. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn.

Unit II

1. Text book of organic chemistry by Morrison and Boyd.
2. Text book of organic chemistry by Graham Solomons.
3. Text book of organic chemistry by Bruice Yuranis Powla.
4. Text book of organic chemistry by Soni.
5. General Organic chemistry by Sachin kumar Ghosh.

Unit III

1. Principles of physical chemistry by Prutton and Marron.
2. Text Book of Physical Chemistry by Soni and Dharmahara.
3. Text Book of Physical Chemistry by Puri and Sharma
4. Text Book of Physical Chemistry by K. L. Kapoor
5. Physical Chemistry through problems by S.K. Dogra.
6. Elements of Physical Chemistry by Lewis and Glasstone.
7. Material science by Kakani & Kakani

Unit IV

1. Vogel's Text Book of Quantitative Analysis by G.H.Jeffery, J.Bassett, J.Mendham and R.C. Denney 5th edn Addison Wesley Longman Inc. 1999.
2. Quantitative Analysis by Day and Underwood Prentice Hall (India) VI Edn..

Optional-II Pharmaceutical Chemistry

Paper-II: Introduction to Human anatomy and physiology (P.CH .204)

U-5: Introduction Anatomical terms: 15 Hrs

Terms in relation to parts of the body, system and organs. Elementary knowledge of the human skeleton. Tissues of the body – properties and functions of epithelial, connective, muscular, nervous and osteous (bone) tissues. General principles of membrane permeability, diffusion, transport, membrane potentials and action potentials.

U-6: Nervous Systems: 15 Hrs

Autonomic nervous system: Physiology and functions of the autonomic nervous system, Mechanism of neurohumoral transmission in ANS; Central Nervous system: Functions of different parts of brain and spinal cord, Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialized functions of the brain, cranial nerves and their functions.

U-7: Cardiovascular System and Respiratory System : 15 Hrs

Heart, blood vessels, cardiac cycle, circulation, blood pressure and its regulations. Blood (composition and function). **Respiratory System:** – Gross anatomy of respiratory passages, physiology of respiration, nervous control of respiration, vital capacity, respiratory volume, introduction to terms such as anoxia, hypoxia & dyspnoea.

U-8: Digestive System & Others: 15 Hrs

Digestive System: – Gross anatomy of alimentary canal, movements of alimentary canal, gastric secretions and the enzymes involved in digestion.

Endocrine System: – general mechanisms of hormonal secretion, Physiological considerations of thyroid, pancreas, pituitary, parathyroid, adrenal glands and gonads. Disorders of hypo and hyper secretion.

Urinogenital System: – Various parts, structure and functions of the kidney and urinary tract. Physiology of urine formation, output and factors controlling it.

Recommended Text Books:

- 1.Principles of anatomy and physiology by Tortora G.J., and N.P. Anagnokokos,
- 2.Principles of Anatomy and Physiology by Ross & Wilson.

Reference Books:

- 1.Human Physiology by C.C. Chatterjee, Medical Allied Agency, India.
- 2.Text Book of Medicinal Physiology by A.C. Guyton, W.B. Prism Books Pvt. Ltd.,

Practical Paper-II: Human Anatomy And physiology(P.CH 252)

LIST OF EXPERIMENTS:

1. Introduction to Instruments used in Physiology Lab.
2. Microscopic study of different tissues
3. Identification of bones and joints
4. Study of different systems with the help of charts and models
5. Estimation of RBC
6. Estimation of WBC
7. Estimation of haemoglobin
8. Different leukocyte count
9. Estimation of erythrocyte sedimentation rate
10. Determination of bleeding time
11. Determination of clotting time
12. Recording of human heart rate and pulse rate
13. Study of effect of posture and exercise on blood pressure
14. Recording human body temperature

Optional-III :Biotechnology

Paper II – Basics of Genetics and Nucleic Acids (BT 205)

U-1. Chromosomes as the basis of heredity and Chromosome Organization

- 1.1 Chromosome organization in Prokaryotes
- 1.2. Levels of organization of Chromosomes in Eukaryotes.
Histones, Nucleosome formation, Chromatid structure-solenoid model
- 1.3 Different classes of chromosomes and basis for identification
- 1.4. Karyotyping - Karyotyping of human chromosomes
Abnormal karyotypes and detection
- 1.5 Structure of specialized chromosomes (Polytene and Lamp Brush)

U-2 Mendel's Laws and deviations of Mendel's laws

- 2.1. Mendel's experiments – Factors contributing to success of Mendel's experiments
- 2.2. Law of segregation – Mono hybrid ratio
- 2.3. Law of Independent assortment – Di hybrids, Tri hybrids
- 2.4. Deviation from Mendel's Laws - partial or incomplete dominance, co-dominance
- 2.5. Epistatic gene interaction – Dominant and recessive epistasis
- 2.6. Penetrance and expressivity, pleiotropism

2.7. Genes and environment – phenocopies

U-3 Linkage and Recombination

- 3.1. Linkage and recombination – Discovery of linkage, cytological proof of crossing over
- 3.2. Recombination frequency and map distance
- 3.3. Interference and coincidence
- 3.4. Mitotic crossing over in *Drosophila*
- 3.5. Mechanism of sex determination-genic balance theory - *Drosophila*
- 3.6. Homogametic and Heterogametic theory (Human, Mammalian, Birds)
- 3.7. X – linked inheritance (eg. Haemophilia)

U-4 Properties and Function of Nucleic Acids

- 4.1. DNA as the genetic material – Griffiths experiments on transformation in *Streptococcus pneumoniae*. Avery, McEleod and Mc Carty’s experiments. Hershey – Chase experiments with radio-labelled T₂ bacteriophage
- 4.2. RNA as genetic material – Tobacco Mosaic Virus
- 4.3. Structure of DNA – Watson and Crick Model
- 4.4. Forms of DNA – A, B and Z forms of DNA, Super coiled and related DNA – Role of Topoisomerases
- 4.5. DNA Replication – Models of DNA replication (Semi-conservative, non-conservative models)
- 4.6. Mechanisms of DNA replication – Linear and circular – Rolling circle and theta mechanism of replication
- 4.7. DNA damage and Repair

Biotechnolgy Practical Paper-BT 253

45 Hrs(3Hrs/Week)

- 1.Problems on Mono hybrid ratios
- 2.Problems on di-hybrid ratio
- 3.Problems on Epistatic gene interactions
- 4.Estimation of DNA by diphenylamine method
- 5.Estimation of RNA by orcinol method
6. Karyotyping
7. Identification of chromosomal abnormalities in various karyotypes
8. Preparation of different stages of Mitosis and Meiosis

Recommended Books

1. Genetics - By Mohan P. Arora, Gurdarshan and S. Sandhu
2. Cell and Molecular Biology - By De Robertis

3. Cell and Molecular Biology - By Lodish
4. Cell Biology and Genetics - By P.K. Gupta
5. Theory and Problems in Genetics - By Stransfield
6. The World of the Cell - By Becker (Pearson Education)
7. Introduction to Biotechnology- By W.J. Thieman and M.A. Palladino (Pearson Education)
8. Discovering Genomics, Proteomics and Bioinformatics - By A.M. Campbell
9. Genetics - By Strickberger (Pearson Education)
10. Fundamental Concepts of Bioinformatics - By Krane (Pearson Education)
11. Genetics - By Gardner (Macmillan Press)
12. An introduction to Genetic Analysis - By Griffith and others – Freeman and Company

(NON-CORE SUBJECT)

Paper-NCII Computer skills (N206)

U – 1: Computer Concepts

U – 2: Programming in ‘C’ language

U-3: Introduction to MS-Office (Word ,Access & excel)

U-4 : Introduction to MS-Office (power point & World Wide Web)

U – 1: COMPUTER CONCEPTS:

Evolution, Basic structure and Characteristics of computers; Types of memory chips; Study of various input – output devices like magnetic tapes, magnetic discs, MICR, OCR, CDROMS etc., Types of printers; Principles of flow charting; Importance of operating systems, detailed study of the operating systems MSDOS , UNIX and WINDOWS; Computer Viruses;

U – 2: PROGRAMMING IN ‘C’ LANGUAGE:

Operators, Expressions, Data input, Output, Control statements like – (IF-ELSE, WHILE DO, FOR, BREAK AND CONTINUE and GOTO) Functions, Library functions, Arrays.

U-3: INTRODUCTION TO MS-OFFICE (WORD ,ACCESS & EXCEL)

MS-Word: Basics, working with files, working with text, formatting paragraphs, styles, lists, tables, Graphics, spellings and grammar and page formatting macros, table of contents.

MS-Excel: Basics, Spreadsheets, data types, formulas, formatting, charts, graphs.

MS –Access: – data base concepts, Screen layouts, Creating tables, Data sheet records, table relationships, Sorting and filtering, Queries, forms, form controls, Sub forms, reports, importing, exporting, linking.

U-4 : INTRODUCTION TO MS-OFFICE (POWER POINT & WORLD WIDE WEB)

MS Power point: Power point basics, Views, Slide control, Apply design, Page setup, Templates, Background, Control, Color Screens, Transitions and animations, working with texts and working with graphics.

Hypertext and World Wide Web (WWW): Structure and Organization of the WWW, WWW browsers, Information search in WWW, search engines, Pharmaceutical resources in WWW Types of indexing tools and search strategies; Internet and E-Mail.

Text Books:

- 1.Fundamentals of Computers by P.K. Sinha
- 2.Let Us C by Yashvanth Kanetkar
- 3.Working in Microsoft Office By Ron Mansfield

Reference Books:

- Programming with 'C' by Byron Goltfield- Schum series
- **Computer programming in 'C'**

M.Sc.5Yr Integrated Pharmaceutical Chemistry III & IV Semester (CBCS) Syllabus
(Effective from academic year 2016-2017 for Campus College)
[UNDER RESTRUCTURED CBCS Scheme]
(Revised by the P.G. BOS meeting on 21-07-17)

Scheme of teaching & examination:

Semester-III

S.No	Subject	Paper (Theory)	Teaching hrs/week	Examination hrs	Internal marks	Final Exam marks	Total marks	Credits
1.	English (E301)	P-III	5	3	10	40	50	5
2.	Telugu (T302) or Sanskrit(S302)	P-III	5	3	10	40	50	5
3.	Chemistry (Chem303)	P-III	4	3	10	40	50	4
4.	Pharmaceutical Chemistry (P.Chem304)	P-III	4	3	10	40	50	4
5.	Biotechnology (Bio.Tech305)	P-II	4	3	10	40	50	4
6.	Personality development(P306) Or Indian constitution & human rights (I306) Or Biostatistics(BST306 (noncore)	NC-III	2	3	10	40	50	2
		Practical classes						
1.	Chemistry (Chem351)	P-III	3	3	--	25	25	2
2.	Pharmaceutical Chemistry (P.Chem352)	P-III	3	3	--	25	25	2
3.	Biotechnology (Bio.Tech 353)	P-II	3	3	--	25	25	2
							375	30

Optional subject-I:Chemistry

Paper-III Chemistry (Chem 303)

U-1 (Inorganic Chemistry)

15 hours

1.1: Chemistry of d-block elements:

9 h

Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states and e.m.f. Comparative treatment of second and third transition series with their 3d analogues. Study of Ti, Cr and Cu traids in respect of electronic configuration and reactivity of different oxidation states.

1.2: Chemistry of f-block elements:

6 h

Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties, spectral properties and separation of lanthanides by ion exchange and solvent extraction methods. Chemistry of actinides – electronic configuration, oxidation states, actinide contraction, position of actinides in the periodic table, comparison with lanthanides in terms of magnetic properties, spectral properties and complex formation.

U- 2 (Organic chemistry)

15 h

2.1: Halogen compounds

6h

Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl). Chemical reactivity - reduction, formation of RMgX , Nucleophilic substitution reaction – classification into $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$. Mechanism of, energy profile diagrams of $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions. Stereochemistry of $\text{S}_{\text{N}}2$ (Walden Inversion), $\text{S}_{\text{N}}1$ (Racemisation) explanation of both by taking the example of optically active alkyl halide- 2-bromo butane. Structure and reactivity – Ease of hydrolysis - comparison of allyl, benzyl, alkyl, vinyl and aryl halides.

2.2: Hydroxy compounds

6 h

Nomenclature and classification of hydroxy compounds. Preparation: from carbonyl compounds . Aryl carbinols by hydroxy methylation. Phenols – (a) by diazotisation (b) from sulfonic acid (c) from cumene (d) by hydrolysis of halobenzene. Physical properties – Hydrogen bonding (inter molecular and intramolecular) effect of hydrogen bonding on boiling point and water solubility Chemical properties (a) acidic nature of Phenols (b) Formation of alkoxide/phenoxides and their reaction with RX (c) replacement of OH by X using PCl_5 , PBr_3 , SOCl_2 and with HX/ZnCl_2 . Esterification by (a) acid halides, anhydrides and acids (mechanism) (b) Esters of inorganic acids (c) dehydration of alcohols. Oxidation of alcohols by CrO_3 , KMnO_4 . Special reactions of Phenols – (a) Bromination , (b) Kolbe- Schmidt reaction (c) Riemer Tiemann (d) Azo coupling . Identification of alcohols by oxidation - KMnO_4 , Ceric ammonium nitrate - Lucas reagent; Phenols by reaction with FeCl_3 , and by the solubility in

NaOH. Poly hydroxyl compounds – Pinacol - Pinacolone rearrangement, Oxidative cleavage ($\text{Pb}(\text{OAc})_4$ & HIO_4).

2.3: Ethers and epoxides

3 h

Nomenclature, preparation by (a) Williamson's synthesis (b) from alkenes by the action of conc. H_2SO_4 . Physical properties – Absence of Hydrogen bonding, insoluble in water, low boiling point. Chemical properties – inert nature, action of conc. H_2SO_4 and HI. Acid and base catalysed ring opening of epoxides- orientation.

U - 3 (Physical Chemistry)

15 hr

3.1. Phase Rule

5 hr

Statement and meaning of the terms – Phase, Component and degrees of freedom, Gibb's Phase rule, phase equilibria of one component system – water system. Phase equilibria of two-component system – Solid-Liquid equilibria, simple eutectic – Pb-Ag system, desilverisation of lead. Solid solutions – compound with congruent melting point – (Mg-Zn) system and incongruent melting point – ($\text{NaCl-H}_2\text{O}$) system.

3.2 Dilute Solutions & Colligative Properties

10hr

Dilute Solutions, Colligative Properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis - laws of osmotic pressure, its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, Van't Hoff factor, degree of dissociation and association of solutes.

U-4(General Chemistry)

15 hr

4.1: Molecular Symmetry:

3 h

Symmetry elements and symmetry operations in molecules. Definition of Plane of symmetry, Center of symmetry and Axis of symmetry (simple axis (C_n) and alternating axis (S_n)). Examples.

4.2: Stereochemistry of carbon compounds

12 h

Isomerism: Definition of homomers and isomers. Classification of isomers: Constitutional and Stereoisomers -. definition and examples. Constitutional isomers: chain, functional, positional isomers and metamerism. Stereoisomers: enantiomers and diastereomers – definitions and examples. Conformational and Configurational isomerism – definition.

Enantiomers: Optical activity: wave nature of light, plane polarised light, interaction with molecules, optical rotation and specific rotation. Chiral molecules: definition and criteria - absence of plane, center and S_n axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans-1,2-dichlorocyclopropane). Chiral centers: definition - molecules with similar

chiral carbons (Tartaric acid) – definition of mesomers. Molecules with dissimilar chiral carbons (2,3-dibromopentane). Number of enantiomers and mesomers - calculation. D, L & R, S configuration for asymmetric and disymmetric molecules. Cahn-Ingold-Prelog rules. Racemic mixture, Racemisation and Resolution techniques

Principles of axial chirality. Stereochemistry of substituted Allenes, Spiranes & Biphenyls - Atropisomerism

Diastereomers: Definition. *Geometrical isomerism* in molecules having C=C, C=N, N=N, and in cyclopropane, cyclobutane & cyclopentane. E, Z – nomenclature. Physical, spectral and chemical methods of determining E, Z configuration.

Laboratory Course:

Paper-III Chemistry (Chem 351)

Qualitative Analysis and Inorganic preparations:

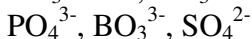
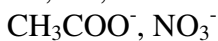
1. Preparation of Complexes

Any three of the following inorganic preparations:

- 1) Ferrous ammonium sulphate
- 2) Tetrammine copper (II) sulphate
- 3) Potassium trisoxalato chromate
- 4) Potash alum $KAl(SO_4)_2 \cdot 12H_2O$
- 5) Hexammine cobalt (III) chloride.

2. Semi micro analysis of mixtures

Analysis of two anions in the given mixture.



Books suggested: (for Semester III)

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A. Cotton, G. Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001. Chem.
4. Principles of Inorganic Chemistry by G.S. Monku.
5. Qualitative Analysis by Welcher and Hahn.
6. Qualitative Inorganic analysis by A.I. Vogel

References

1. Inorganic Chemistry Principles of structure and reactivity by James E. Huhey, E.A. Keiter and R.L. Keiter 4th edn.
2. Chemistry of the elements by N.N. Greenwood and A. Earnshaw Pergamon Press 1989.
3. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.

Unit II

1. Text book of organic chemistry by Morrison and Boyd
2. Text book of organic chemistry by Graham solomons
3. Text book of organic chemistry by Bruce yuranis Powla

4. Text book of organic chemistry by Sony
5. General Organic chemistry by Sachin kumar Ghosh

Unit III

1. Principles of physical chemistry by Prutton and Marron.
2. Text Book of Physical Chemistry by Soni and Dharmahara..
3. Text Book of Physical Chemistry by Puri and Sharma.
4. Elements of Physical Chemistry by Lewis Glasstone.

References

1. Text Book of Physical Chemistry by K. L. Kapoor.
2. Physical Chemistry through problems by S.K. Dogra.
3. Text Book of Physical Chemistry by R.P. Verma.

Unit IV

1. Theoretical Inorganic chemistry by Day and Selbin.
2. Principles of physical chemistry by Prutton and Marron.
3. Text Book of Physical Chemistry by Soni and Dharmahara.
4. Inorganic Chemistry by Gilreath.

References

- Symmetry in chemistry H.H. Jaffe and M. Orchin.

Optional-II Pharmaceutical Chemistry

Paper-III- Pharmaceutical chemistry Inorganic (P.Chem 304)

U-9: Limit tests & Inorganic pharmaceuticals -I

U-10: Inorganic pharmaceuticals -II

U-11: Inorganic pharmaceuticals -III

U-12: Radiopharmaceuticals & pharmaceutical aids

U-1 Limit tests & Inorganic pharmaceuticals –I

15h

Limit tests for metallic impurities: lead, arsenic, iron:. Limit tests for nonmetallic impurities: Boron, free Halogens, Selenium.

Electrolytes: Sodium, Potassium and Calcium replenishers.

Sodium and Potassium Replenishers: Sodium chloride, compound Sodium chloride solution (Ringer solution), Potassium chloride, ORS. **Calcium Replenishers:** Calcium chloride, Calcium gluconate, Dibasic calcium phosphate.

Mineral Nutrients/Supplements: **Haematinics** – Ferrous sulphate, Ferrous fumarate, Ferrous gluconate, Ferric ammonium citrate, iron and dextrose injection. **Halogens:** Iodine and Iodides or fluorides.

U-2:Inorganic pharmaceuticals –II

15h

Gastro-intestinal agents:

(1)**Acidifiers and Antacids:** IP: Dilute hydrochloric acid, sodium acid phosphate, sodium bicarbonate, sodium citrate, Potassium citrate, Aluminium hydroxide gel, Dried Aluminium hydroxide gel, Magnesium oxide (Magnesia), Magnesium-hydroxide mixture, Magnesium carbonate, Magnesium trisilicate, Calcium carbonate.

(2)**Adsorbents and related drugs:** Light kaolin, Heavy kaolin, Activated charcoal.

Acid base Regulators: Sodium bicarbonate, Sodium lactate, Sodium citrate/Potassium citrate, and Sodium acetate, Ammonium chloride.

Dialysis fluids: Haemodialysis fluids and intraperitoneal dialysis fluids.

Antioxidants:Mechanism of action. Preparation, properties and assay of hypophosphorus acid and sodium meta bisulphate

Antidiarrhoeals:Bismuth compounds.

Laxatives: Magnesium sulfate , milk of magnesia v) Topical agents: Introduction, categories (protectives and adsorbents, silicone polymers, antimicrobials and hydrogen peroxide. vi) Astringents: alum

U-3: Inorganic pharmaceuticals –III

15h

Dental products. Introduction, anticaries agents-sodium flouride, dentifriers-dibasic calcium phosphate. **Inhalants:** Introduction, role of oxygen, carbon dioxide and ammonia, nitrous oxide as inhalant. **Expectorants**-Ammonium chloride and Potassium iodide. **Respiratory stimulants:** Dil. ammonia solution, aromatic spirit of ammonia. **Emetics:** Ammonium chloride, potassium iodide. Metal ions as pharmaceuticals.

Anti neoplastic agents: Cis-Platin and Carboplatin and their mechanism of action at molecularlevel. **Anti arthritics**- Auranofin.

Antidiabetics: bis(methylpicolinato)vanadium derivatives. **Cardiovascular agents**-Sodium nitroprusside

Topical agents: Astringents: Zinc sulphate, Zinc oxide, Calcium hydroxide, Copper sulphate, Bismuth sub carbonate Anti infectives: Hydrogen peroxide solution, Potassium permanganate, Silver nitrate (Silver protein), Iodine, (solutions of Iodine, povidone – iodine), Boric acid, Zinc – undecylenate, Mercury compounds (Yellow mercuric oxide, Ammoniated mercury), Sulphur, Selenium sulphide.

U-4: Radiopharmaceuticals & pharmaceutical aids

15h

Introduction, types of radio nuclides, units of radioactivity,

Radiopharmaceuticals in therapeutics, in diagnosis, for sterilisation- Ca-44, Ca-45, C-14, Sr-90, Co-60, Cyanocobalamin(Co-57) Au-198, Fe-59, ¹³¹I, ¹²⁵I and barium sulfate.

Pharmaceutics aids:

Excipients: Dicalcium phosphate, Tricalcium phosphate, Magnesium stearate, Talc and Calcium carbonate (Precipitated chalk).

Suspending agents: Bentonite, Colloidalsilica, Aluminium stearate

Colourants: Titanium oxide, Ferric oxide.

Recommended text books:

1. Inorganic pharmaceutical chemistry By Chatwal
2. Inorganic pharmaceutical chemistry By Mohammadali
3. Inorganic pharmaceutical and medicinal chemistry By Quadri and Quadri
4. Pharmaceutical Drug analysis by Ashtoshkar

References:

1. Inorganic pharmaceutical chemistry By Black
2. Inorganic pharmaceutical chemistry by Bothara
3. British Pharmacopoeia vol I,II
4. Indian Pharmacopoeia vol I,II
5. Bently's Text book of pharmaceutics by Rowlinson
1. The science and practice of pharmacy by Remington

Laboratory**Paper-III: PHARMACEUTICAL ANALYSIS-I (P.Chem 352)**

Limit tests: for iron, Lead and Arsenic in inorganic and organic pharmaceuticals

Assay of Pharmaceuticals

Calibration of weights, pipettes and burette.

(Acid-base titrations)

Assay of Aspirin, Codeine phosphate, sodium bicarbonate and assay of Boric acid

Non-aqueous titrations: Assay of diphenylhydramine hydrochloride in tablets. Assay of ephedrine hydrochloride in capsules. Assay of Ibuprofen in tablets

Recommended Text Books:

1. Practical pharmaceutical chemistry Part I by Beckett & Stenlake
2. Pharmaceutical Drug analysis by Ashtoshkar
3. Vogel's text book of quantitative chemical analysis

Optional-III : Biotechnology**Paper III – Biological Chemistry (Bio.Tech 305)****U-1 Carbohydrates and Proteins**

- 1.1 **Carbohydrates :** Importance, classification and properties
- 1.2 Structure, configuration and biochemical importance of monosaccharides (glucose and fructose)

- 1.3 Disaccharides – Structures and biochemical importance
- 1.4 Physiologically important glycosides (streptomycin, cardiac glycosides, ouabain)
- 1.5 Structure and function of homo polysaccharides – starch, inulin, cellulose and glycogen
- 1.6 Structure and function of heteropolysaccharides – Hyaluronic acid

U-2 Amino acids and proteins

- 2.1 Classification, structure of Amino acids
- 2.2 Three letter and single letter notation of Amino acids
- 2.3 Physico- chemical properties of amino acids
- 2.4 Peptide bond – Synthesis and characters
- 2.5. Different levels of organization of protein structure

Primary, secondary, tertiary and quaternary structures of proteins

- 2.6. Ramachandran plot

U-3 Lipids and Enzymes

- 3.1 Over all classification of Lipids
- 3.2 Classification of Fatty acids : Saturated and unsaturated
- 3.3 Triacylglycerols, Phospholipids Spingolipids, Sterols
- 3.4 **Enzymes** : Classification and nomenclature of enzymes
- 3.5 Factors influencing enzymatic reactions
(a)pH (b) Temperature (c) Substrate concentration (d) Enzyme concentration
- 3.6 Enzyme Inhibition – Competitive, non-competitive and uncompetitive

U-4 Intermediary Metabolism

- 4.1 Glycolysis and Regulation
- 4.2 Citric acid cycle and regulation
- 4.3 Mitochondrial electron transport- Chemiosmotic theory of ATP synthesis
- 4.4 β -Oxidation of fatty acid
- 4.5 Deamination, decarboxylation and transamination reactions of amino acids
- 4.6. Catabolism of amino acids – phenyl alanine and tyrosine (Phenylketonuria and albinism)

Practicals (353)

- 1.Preparation of Normal, Molar and Molal solutions
- 2.Preparation of Buffers (Acidic, Neutral and Alkaline Buffers)
- 3.Qualitative tests of sugars, amino acids and lipids
- 4.Quantitative Estimations of protein by Biuret method
- 5.Quantitative Estimation of total sugars by anthrone method
- 6.Enzyme assay – Catalase or Invertase (or any other enzyme)

Recommended Books

- 1.Biochemistry - By Dr. U. Satyanarayana, U. Chakrapani
- 2.Biochemistry - By J.L. Jain

3. Biochemistry - By Conn and Stumpf
4. Biochemistry - By Lehninger
5. Textbook of Medical Biochemistry - By S. Ramakrishnan, R. Rajan, and K.G. Prasanna (Orient Longman)
6. Biochemistry - By Stryer
7. Biochemistry - By Voet and Voet
8. Biochemistry (Jaypee) - By Vasudevan
9. Biochemistry - By David Rawn
10. General Biochemistry - By J.H. Well
11. Biochemistry - By K. Trehan
12. Biochemical Methods - By S. Sadasivam and A. Manickam
13. An introduction to Practical Biochemistry - By T. Plummer
14. Experimental Biochemistry - A Student Companion - By V. Deshpande and B. Sasidhar Rao
15. Practical Biochemistry – By Upadhyay, Wilson and Wilson, Wilson & Walker

Non core

Personality development (P306)

Or Indian constitution & human rights (I306)

Or Biostatistics (**BST306**)

BIOSTATISTICS (BST306)

U-1:

Basic Mathematical Principles that are commonly used in biology sets, integers, linear and non-linear graphs; 2d Coordinate geometry, Equation of line, circle, ellipse and hyperbola; 3D geometry, equation of sphere and cone; Boolean algebra and logic, bits, bytes; Matrix algebra

U-2:

Nature and Scope of Statistical methods and their limitations, compilation, classification, tabulation and applications in pharma and life sciences; Graphical representation; Measures of Average and Dispersion Stem and Leaf Plots; Box and Whisker Plots, Co-plots; Introduction to Probability Theory and Distributions (Concepts without Derivations), Binomial, Poisson & Normal Distributions (Only definition and Problems)

U-3:

Sampling Methods: Simple, Random, stratified, Systematic and Cluster Sampling Procedures; Data Collection, Data Organization and Data Representation; Bar, Pie, 2-D and 3-D Diagrams; Sampling and Non-Sampling Errors; Sampling Distributions; Principles of Scientific Experiments; Concepts of CRD, RBD and Latin Square Designs;

U-4:

Inference Concerning Means: Point Estimation – Interval estimation – Bayesian estimation – Tests of Hypothesis; Common Parametric and Non parametric tests employed in testing of significance in biological/pharmaceutical experiments and elements of ANOVA (one way and two way)

Statistical basis of biological assays: Response-Dose Metameter, Delusion Assays, direct and Indirect Assays, Standard line Interpolation assay, Parallel line Assay (4 Point and 6 Point Assays) and Slope Ratio Assay; Statistical Quality Control Charts and Application of Statistical Concepts in Pharmaceutical Sciences;

Text and Refence Books:

1. Probability and Statistics by M.R Spiegel Schaum Series
2. Biostatistics: A Foundation for analysis in Health Sciences, by Danial W.W., John Wiley
3. Statistics for Biologists, by Campbell, R.C., Cambridge University Press
4. Practical statistics for experimental Biologists, by Wardlaw, A.C., John Wiley and Sons Inc.

**Scheme of teaching & examination:
Semester-IV**

S.No	Subject	Paper	Teaching hrs/week (Theory)	Examination hrs	Internal marks	Final Exam marks	Total marks	Credits
1.	English (E401)	P-IV	5	3	10	40	50	5
2.	Telugu (T402) or Sanskrit(S402)	P-IV	5	3	10	40	50	5
3.	Chemistry (Chem 403)	P-IV	4	3	10	40	50	4
4.	Pharmaceutical Chemistry (P.Chem404)	P-IV	4	3	10	40	50	4
5.	Biotechnology (Bio.Tech405)	P-III	4	3	10	40	50	4
6.	Community development(CD406) Or Enterprenureship&manag ement practice (EM406) or Microfinance MF(406) (noncore)	NC-IV	2	3	10	40	50	2
		Practical classes						
1.	Chemistry (Chem 451)	P-IV	3	3	--	25	25	2
2.	Pharmaceutical Chemistry (P.Chem 452)	P-IV	3	3	--	25	25	2
3.	Biotechnology (Bio.Tech 453)	P-III	3	3	--	25	25	2
Total							375	30

Optional-I Chemistry
Paper-IV Chemistry (Chem 403)

U-1 (Inorganic Chemistry)

15h

1.1: Theories of bonding in metals:

8 h

Valence bond theory, Explanation of metallic properties and its limitations, Free electron theory, thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors and insulators.

1.2: Metal carbonyls and related compounds –

7 h

EAN rule, classification of metal carbonyls, structures and shapes of metal carbonyls of V, Cr, Mn, Fe, Co and Ni. Metal nitrosyls and metallocenes (only ferrocene).

U- 2 (Organic Chemistry)

15 hr

2.1: Carbonyl compounds:

6h

Nomenclature of aliphatic and aromatic carbonyl compounds, structure of the carbonyl group.

Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids.

Physical properties: absence of hydrogen bonding, keto-enol tautomerism, reactivity of carbonyl group in aldehydes and ketones.

Nucleophilic addition reaction with a) NaHSO_3 , b) HCN , c) RMgX , d) NH_2OH , e) PhNHNH_2 , f) 2,4 DNPH, g) Alcohols-formation of hemiacetal and acetal.

Halogenation using PCl_5 with mechanism.

Base catalysed reactions: a) Aldol, b) Cannizzaro reaction, c) Perkin reaction, d) Benzoin condensation, e) Haloform reaction, f) Knoevenagel reaction.

Oxidation of aldehydes- Baeyer-Villiger oxidation of ketones.

Reduction: Clemmensen reduction, Wolf-Kishner reduction, MPV reduction, reduction with LiAlH_4 and NaBH_4 .

Analysis of aldehydes and ketones with a) 2,4-DNT test, b) Tollen's test, c) Fehling text, d) Schiff test, e) Haloform test (with equation).

2.2: Carboxylic acids and derivatives

6 h.

Nomenclature, classification and structure of carboxylic acids.

Methods of preparation by a) hydrolysis of nitriles, amides and esters.

b) carbonation of Grignard reagents.

Special methods of preparation of aromatic acids by a) oxidation of side chain.

b) hydrolysis by benzotrichlorides.

c) Kolbe reaction.

Physical properties: Hydrogen bonding, dimeric association, acidity- strength of acids with examples of trimethyl acetic acid and trichloroacetic acid. Relative differences in the acidities of aromatic and aliphatic acids.

Chemical properties: Reactions involving H, OH and COOH groups- salt formation, anhydride formation, acid chloride formation, amide formation and esterification (mechanism). Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schimdt reaction, Arndt-Eistert synthesis, halogenation by Hell-Volhard- Zelinsky reaction.

Derivatives of carboxylic acids: Reaction of acid chlorides, acid anhydrides, acid amides, esters (mechanism of the hydrolysis of esters by acids and bases).

2.3: Active methylene compounds

3 h

Acetoacetic esters: preparation by Claisen condensation, keto-enol tautomerism. Acid hydrolysis and ketonic hydrolysis.

Preparation of a) monocarboxylic acids.

b) dicarboxylic acids.

Reaction with urea

Malonic ester: preparation from acetic acid.

Synthetic applications: Preparation of

a) monocarboxylic acids (propionic acid and n-butyric acid).

b) dicarboxylic acids (succinic acid and adipic acid).

c) α,β -unsaturated carboxylic acids (crotonic acid).

Reaction with urea.

Exercises in interconversion

U-3 (Physical Chemistry)

15 hr

3.1. Electrochemistry & EMF

15 hr

Electrical transport – conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution. Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method for attackable electrodes. Applications of conductivity measurements: Determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Electrode reactions, Nernst equation, cell EMF and single electrode potential, standard Hydrogen electrode – reference electrodes – standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolyte and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurement. Computation of EMF.

U-4 (General Chemistry)

15 hr

4.1: Physical properties & Molecular Structures

3hr

Orientation of dipoles in an electric field, dipole movement, induced dipole movement, dipole movement and structure of molecules, magnetic properties- paramagnetism, diamagnetism and ferromagnetism

4.2: Spectrophotometry

4 h

General features of absorption – spectroscopy, Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity. Single and double beam spectrophotometers. Application of Beer-Lambert law for quantitative analysis of

1. Chromium in $K_2Cr_2O_7$
2. Manganese in manganous sulphate
1. Iron (III) with thiocyanate.

4.3: Molecular spectroscopy-I

8 h

(i) Electronic spectroscopy:

Interaction of electromagnetic radiation with molecules and types of molecular spectra. Potential energy curves for bonding and antibonding molecular orbitals. Energy levels of molecules (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules effect of conjugation. Concept of chromophore.

(ii) Infra red spectroscopy

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant. Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Fingerprint nature of infrared spectrum.

(iii) Raman spectroscopy

Concept of polarizability, selection rules, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

Laboratory Course:

Paper- IV: Chemistry (Chem 451)

I Semi micro analysis of mixtures

Analysis of mixtures containing two anions (one simple and one interfering) and two cations (of different groups) from the following:

Anions: CO_3^{2-} , SO_3^{2-} , S^{2-} , Cl^- , Br^- , I^- , CH_3COO^- , NO_3^- , PO_4^{3-} , BO_3^{3-} , SO_4^{2-}

Cations: Ag^+ , Pb^{2+} , Hg^+ , Hg^{2+}
 Pb^{2+} , Bi^{3+} , Cd^{2+} , Cu^{2+} , $As^{3+/5+}$, $Sb^{3+/5+}$, $Sn^{2+/4+}$
 Al^{3+} , Cr^{3+} , Fe^{3+}
 Zn^{2+} , Ni^{2+} , Co^{2+} , Mn^{2+}
 Ca^{2+} , Si^{2+} , Ba^{2+}
 Mg^{2+} , NH_4

Books suggested: (for Semester IV)

Unit- I

6. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
7. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
8. Basic Inorganic Chemistry by F.A. Cotton, G. Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001. Chem.

9.Principles of Inorganic Chemistry by G.S. Monku.

10.Qualitative Analysis by Welcher and Hahn.

6. Qualitative Inorganic analysis by A.I.Vogel

References

4.Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn.

5.Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.

6.Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.

Unit II

6.Text book of organic chemistry by Morrison and Boyd

7.Text book of organic chemistry by Graham solomons

8.Text book of organic chemistry by Bruice yuranis Powla

9.Text book of organic chemistry by Sony

10.General Organic chemistry by Sachin kumar Ghosh

Unit III

4.Principles of physical chemistry by Prutton and Marron.

5.Text Book of Physical Chemistry by Soni and Dharmahara..

6.Text Book of Physical Chemistry by Puri and Sharma.

4. Elements of Physical Chemistry byLewis Glasstone.

References

4.Text Book of Physical Chemistry by K. L. Kapoor.

5.Physical Chemistry through problems by S.K. Dogra.

6.Text Book of Physical Chemistry by R.P. Verma.

Unit IV

5.Theoretical Inorganic chemistry by Day and Selbin.

6.Principles of physical chemistry by Prutton and Marron.

7.Text Book of Physical Chemistry by Soni and Dharmahara.

8.Inorganic Chemistry by Gilreath.

References

•Symmetry in chemistry H.H.Jaffe and M.Orchin.

Optional-II: Pharmaceutical Chemistry
Paper-IV Physical Pharmacy (P.Chem 404)

U-1: Physical properties of drug molecules

U-2: Buffers, isotonic solutions & application to pharmaceuticals

U-3: Rheology

U-4: Micromeritics, Dissolution & Disintegration

U-1: Physical properties of drug molecules:

15h

Physical properties of drug molecules: Dielectric constant and induced polarization, Refractive index and molar refraction, Optical rotation, optical rotary dispersion and circular dichroism. Solutions of non-electrolytes: Properties and types solutions concentration expressions, solutions of non-electrolytes – Ideal and real solutions Colligative properties, Mol. Wt. determinations.

U-2: Buffers, isotonic solutions & application to pharmaceuticals:

15h

Buffered and Isotonic solutions: The Buffer equation – Common ion effect and the buffer equation for weak acid and its salt and a weak base and its salt; pH indicators; Factors influencing pH of buffer solutions; Measurement and calculating tonicity and methods of adjusting tonicity and pH; Buffer capacity and its calculations; Van Slyke equation; Influence of concentration on buffer capacity and maximum buffer capacity;

Buffers in Pharmaceutical and biological systems – in vivo biologic buffer systems Drugs as buffers: Pharmaceutical buffers and their preparation, influence of buffer capacity and pH on tissue irritation, stability vs optimum therapeutic response, pH and solubility.

U-3: Rheology:

15h

Introduction, concept of viscosity, kinematic viscosity, mechanism of enhanced viscosity, factors influencing viscosity-intrinsic and extrinsic factors. Newtonian flow, non-Newtonian flow. Thixotropy, negative thixotropy, Rheopexy & measurement of thixotropy. Determination of rheological properties(flow properties). Selection of viscometers. Newtonian flow – Ostwald viscometer, falling sphere viscometer. Non Newtonian flow – cup & bob viscometer & cone & plate viscometer. Viscoelasticity (introduction only), psychorheology & applications to pharmacy. (problems to be discussed wherever necessary)

U-4: Micromeritics, Dissolution & Disintegration:

15h

Introduction, particle size analysis- concepts of particle size, size distribution, mean size of particulate system, methods of particle size analysis (sieving, microscopic method, sedimentation methods, electrical sensing zone method, optical sensing zone and light diffraction method). Dissolution: Drug absorption, theories of drug dissolution – Diffusion layer model, Danckwert's model & interfacial barrier model. Factors influencing dissolution, dissolution tests for tablets and capsules (basket apparatus, paddle apparatus, flow through cell apparatus). In vitro- in vivo correlation of dissolution. Disintegration tests for tablets, capsules and enteric coated tablets.

Recommended text books:

1.A. Martin, J. Swarbrick & A. Cammarata, "Physical Pharmacy" Lea and

- Febiger, Philadelphia, III Edition, 1983.
2.C.V.S. Subrahmanyam, **Essentials of Physical Pharmacy**, Vallabh Prakashan, Delhi, 2005

Reference Books:

- 1.Physical Pharmaceutics, by Shoton & Ridgway, Oxford press, London.
- 2.A Text Book of Physical Chemistry, by S. Glasstone, Van Nostrand, New Delhi.
- 3.Physical Chemistry by Walter Moore.
- 4.Remington's Pharmaceuticals Sciences, ed A.R. Gennaro, Mack Publishing co., PA.

Laboratory

Paper-IV Physical Pharmacy (P.Chem 452)

List Of Experiments

Minimum 12 experiments of the following shall be conducted

- 1.Determination of density of given powder sample.
- 2.Determination of viscosity liquid sample.
- 3.Determination of surface tension
- 4.Determination of elevation of boiling point.
- 5.Determination of freezing point.
- 6.Ternary phase diagram for a three component system comprising of alcohol water benzene.
- 7.Determination of critical solution temperature of phenol water system.
- 8.Effect of impurity on CST.
- 9.Determination of solubility
- 10.Effect of addition of salt /pH/ cosolvent on the solubility
- 11.Preparation of pharmaceutical buffer using Handerson- Hassenbach equation.
- 12.Determination of buffer capacity.
- 13.Determination of ionisation constant.
- 14.Determination of distribution coefficient of CH₃COOH between n-Butanol & water.
- 15.Determination of kraft point / cloud number of surfactant.

Optional _III Biotechnology

Paper IV – Microbiology and Biophysical Techniques(Bio.Tech405)

Unit I Fundamentals of Microbiology

- 1.1 Outline of classification of Bacteria- Bergey's manual
- 1.2 Structure and general characters of bacteria

- 1.3 Structure and general characters of Fungi
- 1.4 Structure and general characters of Viruses
- 1.5 Disease causing pathogens and their symptoms (examples; Typhoid, Tuberculosis and HIV only).

Unit II: Isolation and Identification of Microorganisms

- 2.1 Culture media Isolation, identification and preservation of microorganisms (Bacteria)
- 2.2 Identification and preservation methods of Fungi
- 2.3 Methods of sterilization
- 2.4 Bacterial reproduction and growth kinetics (Batch and continuous cultures)
- 2.5 Pure cultures and cultural characteristics

UNIT – III :Principles and Applications of Biophysical Techniques I

- 3.1 Microscopy – Light, Inverted, Fluorescent and Electron microscopy
- 3.2 Colorimetry – Beer – Lambert’s Law
- 3.3 UV-VIS Spectrophotometry
- 3.4 Chromatography
 - 1) Paper (b) Thin Layer (c) Ion-exchange (d) Gel-filtration

Unit IV : Principles and Applications of Biophysical Techniques II

- 4.1 Electrophoresis – Native gels and SDS-PAGE, Agarose
- 4.2. Centrifugation and filtration – Basic Principles
- 4.3. Dialysis and lyophilization
- 4.4. Radio isotopes and their use in Biology and Chemistry

Practicals 453

1. Separation of amino acids by paper chromatography
2. Electrophoretic separation of proteins (SDS-PAGE)
3. Technique of Micrometry (Stage and ocular)
4. Preparation of routine microbiological media
5. Isolation of common non-pathogenic bacteria
6. Staining and identification of bacteria – *E.coli*, *Pseudomonas*, *Bacillus* and *Staphylococcus*.

Recommended Books

- 1.Text Book of Microbiology - By Ananthanarayan and Paniker
- 2.Microbiology - By Cappuccino (Pearson Education)
- 3.Microbiology - By Tortora (Pearson Education)
- 4.Microbiology - B.J. Pelczar, E.S.N. Cfan and N.R. Kreig, McGraw Hill Publ.
5. General Microbiology – By Stanier, R.Y, J.L. Ingrahm, M.L. Wheel is & P.R. Painter
6. General Microbiology – By Powar (Vol. I and Vol. II).
7. Practical Microbiology - By Aneja.
8. An introduction to Practical Biochemistry - By T. Plummer
9. Experimental Biochemistry - A Student Companion - By V. Deshpande and B. Sasidhar Rao

10. Practical Biochemistry – By Upadhayay,
11. Practical Biochemistry - Wilson and Wilson, Wilson & Walker

Non-Core

Entrepreneurship and Development (PD406)

Objective:

It Provide exposure to the students to the entrepreneurial culture and industrial growth so as to preparing them to set up and manage their own small units.

Unit – I:

Introduction: The entrepreneur-Definition; Emergence of entrepreneurial class; Theories of entrepreneurship; Role of socio –economic environment; Characteristics of entrepreneur; Leadership; Risk taking; Decision –making and business planning.

Unit-II

Promotion of a Venture: Opportunities analysis; External environment analysis –economic, social and technological; Competitive factors; legal requirements for establishing of a new unit and rising of funds; venture capital sources and documentation required.

Unit-III

Entrepreneurial Behaviour: Innovation and entrepreneur; Enterpreneurial behavior and psycho-theories, Social Responsibility.

Unit-IV

Entrepreneurial Development Programmes (EDP): EDP, their role, relevance and achievements: Role of Goveernment in organizing EDPs: Critical Evaluation.

Books Recommended:

1. Entrepreneurial Development V.Gangadhar, S. NarasimhaChary, G. Naresh Reddy, P. Amarveni, K. Rajender.
2. Entrepreneurial Development- Khanna, S. Chand & Co.
3. Fundamental of Entrepreneurial Development – R.Saibaba, Kalyani Publishers.
4. The Dyanamic of Entrepreneurial Development and Management; Vasant Desai, 2007 ed., Himalaya Publishing House.
5. Entrepreneurial Development, S.B. Kanka, 2007, S. Chand & Co.
6. Financial Management – Khan & Jain, TMH
7. Entrepreneurship and Small Business Managemnt; Dr. CB. Gupta, Dr. S.S. Kanaka – Sultan Chand & Sons 2006.
8. Business Environment, RajnAgarwal, 2005, Excel Books.
9. Entrepreneurship

Mahatma Gandhi University, Nalgonda
DEPARTMENT OF CHEMISTRY & PHARMACEUTICAL SCIENCES
M.Sc.5Yr Integrated Pharmaceutical Chemistry CBCS Syllabus
(Effective for students admitted from academic year 2015-2016 for Campus College)
[UNDER RESTRUCTURED CBCS Scheme]
(Revised in the P.G. BOS meeting held on 21-07-17)

Scheme of teaching & examination:

Semester-V

S.No	Subject	Paper	Teaching hrs/week (Theory)	Examination hrs	Internal marks	Final Exam marks	Total marks	Credits
1.	Chemistry (Chem501)	P-V	3hr	3	10	40	50	3
2.	Chemistry (Chem502)	P-VI	3	3	10	40	50	3
3.	Pharmaceutical Chemistry (P.Chem503)	P-V	4	3	10	40	50	3
4.	Pharmaceutical Chemistry (P.Chem504)	P-VI	4	3	10	40	50	3
5.	Biotechnology Bio.Tech(505)	P-IV	3	3	10	40	50	3
6.	Biotechnology Bio.Tech(506)	P-V	3	3	10	40	50	3
		Practical classes						
1.	Chemistry (551)	P-V	3	3	--	25	25	2
2.	Chemistry (Chem552)	P-VI	3	3	--	25	25	2
3.	Pharmaceutical Chemistry (P.Chem553)	P-V	2	3	--	25	25	2
4.	Pharmaceutical Chemistry (P.Chem554)	P-VI	2	3	--	25	25	2
5.	Biotechnology (Bio.Tech555)	P-IV	3	3	--	25	25	2
6.	Biotechnology (Bio.Tech556)	P-V	3	3	--	25	25	2
Total							450	30

Optional-I: Chemistry**Paper-V: Chemistry (Chem 501)****U-1 (Inorganic chemistry)****11 hrs****1.1 Coordination Chemistry:****7h**

IUPAC nomenclature, bonding theories – review of Werner’s theory and Sidgwick’s concept of coordination, Valence bond theory, geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal field theory, splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes – low spin and high spin complexes – factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds – structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

1.2 Spectral and magnetic properties of metal complexes: 4h

Electronic absorption spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ ion. Types of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility – Gouy method.

U-2 (Organic chemistry)**11 h****2.1: Nitrogen compounds****11 h**

Nitro hydrocarbons: Nomenclature and classification – nitro hydrocarbons –structure. Tautomerism of nitroalkanes leading to aci and keto form. Preparation of Nitroalkanes . Reactivity - halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Michael addition and reduction. Aromatic Nitro hydrocarbons: Nomenclature, Preparation of Nitrobenzene by Nitration (mechanism), from diazonium salts. Physical properties, chemical reactivity – orientation of electrophilic substitution on nitrobenzene. Reduction reaction of Nitrobenzenes in different media.

Amines (Aliphatic and Aromatic): Nomenclature, classification into 1^0 , 2^0 , 3^0 Amines and Quarternary ammonium compounds. Preparative methods – 1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman’s bromamide reaction (mechanism). Reduction of Amides and Schmidt reaction. Physical properties and basic character – Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline- comparative basic strength of aniline, N- methylaniline and N,N- dimethyl aniline (in aqueous and non- aqueous medium), steric effects and substituent effects. Use of amine salts as phase transfer catalysts. 4. Chemical Properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation. 5. Reaction with Nitrous acid of 1^0 , 2^0 , 3^0 (Aliphatic and aromatic amines). Electrophilic substitutions of Aromatic amines – Bromination and Nitration, oxidation of aryl and 3^0 Amines, diazotisation. 6. Diazonium salts: Preparation with mechanism. Synthetic importance – a) Replacement of diazonium group by – OH, X (Cl)- Sandmeyer and Gatterman reaction, by fluorine (Schiemann’s reaction), by iodine, CN, NO_2 , H and aryl groups. Coupling Reaction of diazonium salts. i) with phenols ii) with anilines. Reduction to phenyl hydrazines.

Cyanides and isocyanides: Nomenclature (aliphatic and aromatic) structure. Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes. Preparation of isocyanides from Alkyl halides and Amines. 2. Properties of cyanides and isocyanides, a) hydrolysis b) addition of Grignard reagent iii) reduction iv) oxidation.

U-3 (Physical Chemistry)

11 hrs

3.1 CHEMICAL KINETICS:

Introduction to chemical kinetics, rate of reaction, variation of concentration with time, rate laws and rate constant. Specific reaction rate.

Factors influencing reaction rates: effect of concentration of reactants, effect of temperature, effect of pressure, effect of reaction medium, effect of radiation, effect of catalyst with simple examples, order of reaction.

First order reaction, derivation of equation for rate constant. Characteristics of first order reaction. Units for rate constant. Half- life period, graph of 1st order reaction, examples. Decomposition of H₂O₂ and decomposition of oxalic acid.

Pseudo first order reaction, Hydrolysis of methyl acetate, inversion of cane sugar, problems.

Second order reaction, derivation of expression for 2nd order rate constant, examples- Hydrolysis of ester, $2O_3 \rightarrow 3O_2$, $C_2H_4 + H_2 \rightarrow C_2H_6$. characteristics of second order reaction, units for rate constants, half- life period and second order plots.

Zero order reaction: derivation of rate expression, examples i) combination of H₂ and Cl₂ to form HCl, ii) thermal decomposition of HI on gold surface characteristics of Zero order reaction units of k, half-life period and graph, problems.

Determination of order of reaction: i) method of integration, ii) half life method, iii) vant-Hoff differential method iv) Ostwald's isolation method

Problems :Effect of temperature on reaction rate, Arrhenius equation. Temperature coefficient

Concept of energy of activation , determination of energy of activation from Arrhenius equation and by graphical method, problems. Simple collision theory based on hard sphere model explanation of frequency factor, orientation or steric factor.

U-4 General chemistry

12h

4.1 Reactivity of metal complexes:

3h

Labile and inert complexes, ligand substitution reactions – S_N1 and S_N2, Substitution reactions of square planar complexes – Trans effect and applications of trans effect.

4.2: Heterocyclic Compounds

5 h

Introduction and definition: Simple 5 membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole. Importance of ring system – presence in important natural products like hemoglobin and chlorophyll. Numbering the ring systems as per Greek letter and Numbers. Aromatic character – 6- electron system (four-electrons from two double bonds and a pair of non-bonded electrons from the hetero atom). Tendency to undergo substitution reactions.

Resonance structures: Indicating electron surplus carbons and electron deficient hetero atom. Explanation of feebly acidic character of pyrrole, electrophilic substitution at 2 or

5 position, Halogenation, Nitration and Sulphonation under mild conditions. Reactivity of furan as 1,3-diene, Diels Alder reactions (one example). Sulphonation of thiophene purification of Benzene obtained from coal tar). Preparation of furan, Pyrrole and thiophene from 1,4,- dicarbonyl compounds only, Paul-Knorr synthesis, structure of pyridine, Basicity – Aromaticity – Comparison with pyrrole – one method of preparation and properties – Reactivity towards Nucleophilic substitution reaction – chichibabin reaction.

4.3: PHOTOCHEMISTRY:

4 hrs

Introduction to photochemical reactions, Difference between thermal and photochemical reactions, Laws of photo chemistry- Grotthus _Draper law, Stark – Einsteins Law of photo chemical equivalence.

Quantum yield. Examples of photo chemical reactions with different quantum yields. Photo chemical combinations of $H_2 - Cl_2$ and $H_2 - Br_2$ reactions, reasons for the high and low quantum yield. Problems based on quantum efficiency,

Consequences of light absorptions. Singlet and triplet states. Jablonsky diagram Explanation of internal conversion, inter- system crossing, Phosphorescence, fluorescence. Photo-sensitized reactions examples i) decomposition of hydrogen molecule in the presence of Hg. ii) dissociation of oxalic acid in presence of UO_2^{2+} ion.

Books suggested & References:

- 1.Principles of Inorganic chemistry by Puri ,Sharma, and Kalia
- 2.Concise Inorganic Chemistry by J.D.Lee 3rd edn
- 3.Basic Inorganic Chemistry by F.A.Cotton ,G.Williams
- 4.Inorganic Chemistry by Shriver and Atkins 3rd edn.
- 5.Text book of organic chemistry by Morrison and Boyd
- 6.Text book of Organic Chemistry byGraham Solomons
- 7.Principlesof Physical Chemistry by Soni and Dharmahara.
- 8.Text book of Physical Chemistry by Puri and Sharma
- 9.Text book of Physical Chemistry by R.P Verma.
- 10.Physical Chemistry by Atkins
- 11.Elements of Physical Chemistry by Lewis Glasstone
- 12.Chemical Kinetics by K.J.Laidler

Optional subject –I :Chemistry

Paper-VI Chemistry (502)

U-1

1.1: Separation techniques

11 h

Solvent extraction: Principle and process, Batch extraction, continuous extraction and counter current extraction. Application – Determination of Iron (III)

Chromatography: Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, R_f values, factors effecting R_f values.

- A. Paper Chromatography: Principles, R_f values, experimental procedures, choice of paper and solvent systems, developments of chromatogram –

- ascending, descending and radial. Two dimensional chromatography, applications.
- B. Thin layer Chromatography (TLC): Advantages. Principles, factors effecting R_f values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots. Applications.
 - C. Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation technique. Applications
 - D. Ion Exchange Chromatography : Theory, Cation and anion exchange resins- Action of cation and anion exchange resin. Applications.
 - E. High performance liquid chromatography (HPLC) : Principles and advantages.

U-2 Molecular spectroscopy-II

12 h

2.1 Proton magnetic resonance spectroscopy (¹H-NMR)

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. NMR Instrument, Chemical shift, Factors effecting chemical shifts, NMR splitting of signals – spin-spin coupling, coupling constants. Applications of NMR with suitable examples – ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene.

2.2 Spectral interpretation

Interpretation of IR, UV-Visible, ¹H-NMR and mass spectral data of the following compounds 1. Phenyl acetylene 2. Acetophenone 3. Cinnamic Acid 4. para-nitro aniline.

U-3 Physical chemistry

11h

3.1 Macromolecules:

Definition of polymers – natural polymers and synthetic polymers with examples. Classification of polymers as plastics, fibers, elastomers. Thermosetting and thermoplastic polymers. Branched, cross-linked and co-polymers. Tacticity, types of tacticity. Definition of polymerization-addition and condensation polymerization with examples. Co-polymerization and co-ordination polymerization : stereo specific synthesis- Zeigler- Natta catalyst.

Molecular weight definitions- number average, weight average molecular weight.

Determination of molecular weight of polymers using Viscosity method and Osmometric method. Problems.

Preparation and industrial applications of poly vinyl chloride (PVC), Nylon –66, Teflon, Terelene.

U-4 General chemistry

11h

3.2 Material science:

6 hours

Classification of materials- classification as metals, ceramics, organic polymers, composites, biological materials, etc. The property of super conductivity in materials.

Super conducting materials- elements, alloys and compounds. Properties of super conductors- zero resistivity, Meisener-Ochsenfeld effect and thermal properties.

Composites- meaning of composites, advanced composites, classification –particle reinforced fiber reinforced and structural composites general characters of composite materials
Particle- reinforced composites – large particle and dispersion- strengthened composite.
Fiber reinforced composites (continuous and discontinuous fiber composites)

Books suggested & References:

1. Chromatography by B.K.Sharma
2. Chromatographic Methods by Stock and Rice
3. Introduction to Chromatography by Srivastava
4. Instrumental Methods of Chemical Analysis by B.K.Sharma
5. Polymer Science by Gouriker, Viswanathan and Jayadev Sridhar
6. Introductory Polymer Chemistry by G.S.Misra
7. Material Science by S.K.Kakani and Amitkalani
8. Vogel's Text book of Qualitative Analysis edited by Bassett and others

SEMESTER V

Laboratory Course:

Paper V(Organic Chemistry) (Chem 551) 45 h (3h/w)

1.Synthesis of Organic compounds:

- Acetylation of salicylic acid, Benzoylation of Aniline.
Aromatic electrophilic substitution: Nitration: Preparation of nitro benzene and m-dinitro benzene.
Halogenation: Preparation of p-bromo acetanilide
Preparation -2,4,6-tribromo phenol
Oxidation: Preparation of benzoic acid from benzyl chloride.
Esterification: Preparation of n-butyl acetate from acetic acid.
Methylation: Preparation of 1-naphthyl methyl ether.
Condensation: Preparation of benzilidene aniline and Benzaldehyde and aniline.
Diazotisation: Azocoupling of β -Naphthol.

References: Practical Organic Chemistry by Mann and saunders.
Practical Organic Chemistry by Vogel

Paper –VI physical chemistry (Chem 552) 45 Hrs (3 hr/week)

1.Non instrumentation:

1. Determination of partition coefficient of iodine between carbon tetra chloride and water.
2. Determination of partition coefficient of acetic acid between n- butanol and water.
3. Verification of Freundlich adsorption isotherm for acetic acid on animal charcoal.
4. Determination of Surface tension and Viscosity of liquids.

2.Instrumentation:

1. Determinations of strength of HCl conductometrically using standard sodium hydroxide solution.
2. Determinations of strength of acetic acid conductometrically using standard sodium hydroxide solution.
3. Determination of cell constant of the given conductivity cell.
4. Determination of dissociation constant K_a of acetic acid by conductivity measurements – Verification of Ostwald's dilution law.

References: Practical Physical Chemistry by Khosla and Garg.

SEMESTER-V

Optional Subject: Pharmaceutical Chemistry

Paper-V Pharmaceutical Engineering (P.Chem 504)

U-17: Fluid flow and Transportation of materials

U-18: Heat Transfer and Evaporation

U-19: Drying, Extraction and Crystallization

U-20: Mixing, Size reduction and size separation

U-17: Fluid flow and Transportation of materials

Fluid Flow: Types of flow, Manometers, Bernoulli's theorem. Measurement of fluids flow rate – orifice, venturi, pitot and rotameter. Pipes, tubes, joints, fittings, valves, reciprocating and rotary pumps, centrifugal and peristaltic pumps, vacuum pumps and jet pumps.

Classification, principles of construction & uses of different types of conveyers, detailed study of belt, screw and pneumatic conveyers

U-18: Heat Transfer and Evaporation

Heat Transfer : Nature of heat flow,

Conduction: - Fourier's law, thermal conductivity, compound resistance in series, heat flow through a cylinder. **Convection:** - Natural and forced convection, temperature gradients in forced convection, surface and overall coefficients. Parallel current and counter current flow.

Radiation: – Stefan Boltzmann law. Heaters, heat interchangers & exchangers.

Evaporators – Classification, short tube, long tube, vertical forced circulation & film evaporators. Evaporation under reduced pressure.

U-19: Drying, Extraction and Crystallization

Extraction – Solid liquid Extraction, theory, problems of crude drug Extraction, solvents, properties choice and recovery. Factors affecting choice of Extraction process and efficiency of Extraction. Maceration, percolation and continuous Extraction process. Solid-liquid and liquid-liquid extraction equipment.

Drying – Theory of drying, tray, vacuum tunnel, rotary and infrared dryer. Drying of slurries of solution – Drum, spray, freeze drying and fluidized bed drying.

Crystallisation – Importance of crystal purity, size, shape, geometry, habit, forms and types. Solubility curves and calculation of yields. Classification of crystallizers- Miers supersaturation theory. Tank, agitated batch, Swenson Walker, single vacuum, and Krystal crystallizers.

U-20: Mixing, Size reduction and size separation

Mixing – Definition and objectives; Types of mixers, Equipment for Solid – solid mixing. V-type mixers, ribbon blender, solid-liquid mixing of viscous masses; Kneading and ban burry mixtures; Ointment mills, triple roller mill. Liquid – liquid characteristics, ion exchange resins, applications.

Size reduction – Objectives, properties of solids, Classification of equipment. Important intermediate crushers, Hammer mills, Ball mills, colloid mill, fluid energy mills.

Screening equipment for coarse and fine powders. Cyclone separators, bag filters, scrubbers. Laws of settling, sedimentation, Elutriation.

TEXT BOOKS :

1. Unit operations to chemical engineering by W.I. Macaube and J.C. Smith, Macrohill Int. book Co, London
2. Pharmaceutical Engineering by Prof. K. Samba murthy
3. Introduction to Chemical engineering by W.L. Badger and Banchemo, Macrohill Int. book Co, London.
4. Unit Operations by Robert Brown

REFERENCE BOOKS:

1. The theory and practice of Industrial Pharmacy by L. Lachman, H. Lieberman and J.L. Kanig, Lea and Febiger Philadelphia.
2. Elements of Chemical Engineering – McCabe & Smith 4th edn. 2000.
3. Handbook of Chemical Engineering by Perry.

SEMESTER-V

Paper-VI: Pharmaceutical analysis-I (P.Chem 506)

U-21: Statistical validation & computation of results

U-22: Pharmaceutical assay by neutralization titrations

U-23: Pharmaceutical assay by redox reactions

U-24: Pharmaceutical assay by complexometry & precipitation

U-21: Statistical validation & computation of results

Introduction, classification, accuracy, precision, minimization of systemic errors. Statistical validation & Computation of analytical results - Statistical treatment of finite examples (mean, median, average deviation, standard deviation, coefficient variation and

variance calculations). Distribution of random numbers. Significant figures- computation rules. Comparison of results (students t-test, variance-ratio test or f-test), method of least squares.

U-22: Pharmaceutical assay by acidimetry

Introduction to titrimetry, primary standards.

Acid -base titrations: Titration curves, systemic equilibrium calculations, theory of indicators, selection of indicator. Non-aqueous titrations- theory, saponification value of fixed oils, determination of ester value. eg. Assay of sodium salicylate, aspirin, ibuprofen, phenobarbitone, methyl dopa..

U-23: Pharmaceutical assay by redox reactions

Redox titrations: Electrode potentials, Nernst equation, calculations, formal potentials, titration curves. Feasibility of redox titrations, types and selection of redox indicators, structural chemistry of redox indicators. eg. Assay of Hydrogen peroxide by permanganometry, Assay of ascorbic acid by Cerimetry, Assay of analgin, isoniazid and chloramine by iodometry..

U-24: Pharmaceutical assay by complexometry & precipitation

Complexometric titrations: Stability of complexes, titration curves, metal ion indicators- Properties and theory. Types of EDTA titrations. Titration of mixture. eg: Determination of calcium gluconate in calcium gluconate injection, Zinc in Bacitracin zinc.

Precipitation titrations: Solubility product, titration curves, determination of end points. Formation of a colored precipitate, formation of a soluble colored compound, use of adsorption indicators. eg. Determination of chloral hydrate in dichlorophenazine, chloride in thiamine hydrochloride

Recommended Text Books:

1. Practical pharmaceutical chemistry Part I by Beckett & Stenlake
2. Pharmaceutical Drug analysis by Ashtoshkar
3. Vogel's text book of quantitative chemical analysis

References:

- .
- British Pharmacopoeia vol I,II
 1. Indian Pharmacopoeia vol I,II
 2. Fundamentals of analytical chemistry. By Skoog and West.
 3. Pharmaceutical analysis. By Takeru, Higuchi
 4. Pharmaceutical analysis By. David G. Watson

Laboratory

Paper-V Pharmaceutical analysis-II (P.Chem 553)

Assay of pharmaceuticals (Redox titrations)

Assay of analgin in tablets by iodometry

Assay of ascorbic acid in raw material by iodometry

Assay of isoniazid in tablets by iodometry
Assay of ascorbic acid in tablets by cerimetry
Determination of hydrogen peroxide in medicament by Permanganometry

Complexometric titrations:

1. Assay of Calcium in Calciumgluconate
2. Assay Zinc in Bacitracin zinc

Precipitation titrations

Assay of chloride- in Ringers lactate , Chloral hydrate.

References :

1. Practical pharmaceutical chemistry Part I by Beckett & Stenlake
2. Pharmaceutical Drug analysis by Ashtoshkar
3. Indian Pharmacopaeia (I.P) Vol.-I & II, Controller of Publications, The Ministry of Health and Family Welfare, Government of India, New Delhi, 1996.

Paper-VI Quantitative estimation of organic compounds (P.Chem 554)

Quantitative estimation of the following compounds by volumetric analysis:

Phenol, Aniline, Ethyl methyl ketone, Glucose., Unsaturation, saponification value and Acid value

References :

Vogels Text Book of Practical Organic Chemistry, 5th edition, ELBS, 1996.

Optional-III Biotechnology

Paper V – Molecular Biology (Bio.Tech505)

U-1 Gene and Genome Organization

- 1.1 Organization of nuclear genome – Genes and gene numbers – essential and non essential genes
- 1.2 Denaturation and renaturation of DNA - T_m values and Cot curves
- 1.3 Kinetic classes of DNA - Single copy sequences, and repeated sequences. Inverted, tandem and palindromic repeats
- 1.4 Satellite DNA

U-2 Organellar Genome Organization

- 2.1 Mitochondrial genome organization (eg: Human)
- 2.2 Chloroplast genome organization in plants
- 2.3 Organization of eukaryotic genes - Exons, introns, promoters and terminators
- 2.4 Gene families and clusters – eg. Globin gene, histones and ribosomal genes.

U-3 Gene expression

- 3.1 Prokaryotic and Eukaryotic Transcription
- 3.2 Post-transcriptional modifications (Capping, polyadenylation, splicing and alternate splicing)
- 3.3 Translation
- 3.4 Genetic code and its features, Wobble Hypothesis
- 3.5 Synthesis of polypeptides - initiation, elongation and termination in prokaryotes and eukaryotes.

U-4 Gene Regulation

- 4.1 Regulation of gene expression in prokaryotes
- 4.2 Regulation of gene expression in eukaryotes
- 4.3 Operon concept in bacteria – Lac operon.

Practicals

1. Isolation of DNA from plant/animal/bacterial cells
2. Analysis of DNA by agarose gel electrophoresis
3. Restriction digestion of DNA
4. Preparation of competent cells of Bacteria
5. Bacterial transformation and selection of transformants under pressure (antibiotic).

Recommended Books

1. Concepts in Biotechnology - By D. Balasubramanian, C.F.A. Bryce, K. Dharmalingam, J. Green and Kunthala Jayaraman
2. Essential Immunology - By I. Roitt, Publ: Blackwell
3. Molecular Biology of the Gene - By Watson, Hopkins, Goberts, Steitz and Weiner
4. (Pearson Education)
5. Cell and Molecular Biology - By Robertis & Robertis, Publ: Waverly
6. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
7. Gene Structure & Expression - By J.D. Howkins, Publ: Cambridge
8. Molecular Biology of the Gene - By Watson, Hopkins, Goberts, Steitz and Weiner
9. (Pearson Education)
10. Cell and Molecular Biology - By Robertis & Robertis, Publ: Waverly
11. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
12. Gene Structure & Expression - By J.D. Howkins, Publ: Cambridge
13. Molecular Biology - By D. Freifelder, Publ: Narosa
14. Genes and Genomes – By Maxine Singer and Paul Berg
15. Cell and Molecular Biology - By S.C. Rastogi
16. From Genes to Clones - By E.L. Winnacker, Publ: Panima, New Delhi
17. Genes - By B. Lewin - Oxford Univ. Press
18. Molecular Biology & Biotechnology - By H.D. Kumar, Publ: Vikas
19. Gene Biotechnology - By Jogdand
20. Genome - T.A. Brown
21. Gene Cloning - T.A. Brown

Optional-III Biotechnology (Bio.Tech506)
Paper VI – Genetic Engineering and Immunology

U-1 Recombinant DNA Technology - I

- 1.1 Enzymes used in gene cloning : Restriction endonucleases, Ligases, Phosphatases, Methylases, Kinases
- 1.2 Cloning vehicles – Plasmids, Cosmids, Phage vectors, Shuttle vectors
- 1.3 Baculovirus vector system, Expression vectors - expression cassettes

U-2 Recombinant DNA Technology – II

- 1 Construction of genomic and cDNA libraries
- 2.2 Identification of cloned genes
- 2.3 Principles involved in Blotting Techniques – Southern, Northern and Western
- 2.4 Principles and Applications of PCR Technology
- 2.5 DNA Finger printing technique and its applications

U-3 Basics of Immunology

- 1 Introduction to immune system – Organs and cells of the immune system
- 3.2 Antigens, Haptens – physico-chemical characteristics
- 3.3 Structure of different immunoglobulins and their functions – Primary and secondary antibody response
- 3.4 Antigen - Antibody Reaction

U-4 Histocompatibility Complexes

- 4.1 The Major Histocompatibility gene complex and its role in organ transplantation, Generation of antibody diversity
- 4.2 Hypersensitivity – Coombs classification, Types of hypersensitivity
- 4.3 Autoimmune diseases – mechanisms of auto immunity
- 4.4 Production of polyclonal antibodies.

Practicals:

- 1.Immuno-diffusion test
- 2.ELISA Test
- 3.Micro agglutination using micro titer plates (eg. ABO and Rh Blood grouping)
- 4.Viability tests of cells/bacteria (Evans blue test or Trypan blue test)
- 5.Coombs's test

Recommended Books

- 1.Concepts in Biotechnology - By D. Balasubramanian, C.F.A. Bryce,

- K. Dharmalingam, J. Green and Kunthala Jayaraman
2. Essential Immunology - By I. Roitt, Publ: Blackwell
 3. Genetic Engineering - By R. Williamson, Publ: Academic Press
 4. Test Book of Molecular Biology - By K.S. Sastry, G. Padmanabhan & C. Subramanyan,
Publ: Macmillan India
 5. Microbial Genetics - By S.R. Maloy, J.E. Cronan & D. Freifelder, Publ: Jones & Barlett
 6. Principles of Gene Manipulation - By R.W. Old & S.B. Primrose, Publ: Blackwell
 7. Immunology - By G. Reeve & I. Todd, Publ: Blackwell
 8. Methods for General & Molecular Bacteriology - By P. Gerhardt et al., Publ: ASM
 9. Molecular Biotechnology - By G.R. Click and J.J. Pasternak, Publ: Panima
 10. Recombinant DNA - By J.D. Watson et al., Publ: Scientific American Books
 11. Immuno diagnostics - By S.C. Rastogi, Publ: New Age
 12. Genetic Engineering and Biotechnology - By V. Kumar Gera
 13. Essentials of Biotechnology - By P.K. Gupta
 14. Introduction to Applied Biology and Biotechnology - By K. Vaidyanath, K. Pratap Reddy
and K. Satya Prasad
 15. Laboratory Experiments in Microbiology - By M. Gopal Reddy, M.N. Reddy, D.V.R. Sai
Gopal and K.V. Mallaiah
 16. Immunology - By Kubey
 17. Biotechnology, IPRs and Biodiversity - By M.B. Rao and Manjula Guru
(Pearson Education)
 18. Introduction to Biotechnology - By W.J. Thieman and M.A. Palladino
(Pearson Education)
 19. Genetic Engineering - By Boylan (Pearson Education)
 20. Basic Concepts of Biotechnology - By Irfan Ali Khan and Atiya Khanum
(Ukaaz Publications)
 - 21. Genetic Engineering - By Sandhya Mitra.**

Mahatma Gandhi University, Nalgonda
DEPARTMENT OF CHEMISTRY & PHARMACEUTICAL SCIENCES
M.Sc.5Yr Integrated Pharmaceutical Chemistry CBCS Syllabus
(Effective for students admitted from academic year 2015-2016 for Campus College)
[UNDER RESTRUCTURED CBCS Scheme]
(Revised in the P.G. BOS meeting held on 06-12-17)

Scheme of teaching & examination:

Semester-VI

S.No	Subject	Paper	Teaching hrs/week (Theory)	Examination hrs	Internal marks	Final Exam marks	Total marks	Credits
1.	Chemistry (Chem601)	P-VII	3	3	10	40	50	3
2.	Chemistry (Chem602)	P-VIII	3	3	10	40	50	3
3.	Pharmaceutical Chemistry (P.Chem603)	P-VII	3	3	10	40	50	3
4.	Pharmaceutical Chemistry (P.Chem604)	P-VIII	3	3	10	40	50	3
5.	Biotechnology (Bio.Tech605)	P-V	3	3	10	40	50	3
6.	Biotechnology (Bio.Tech606)	P-VI	3	3	10	40	50	3
		Practical classes						
1.	Chemistry . (Chem651)	P-V	3	3	--	25	25	2
2.	Chemistry . (Chem652)	P-VI	3	3	--	25	25	2
3.	Pharmaceutical Chemistry (P.Chem653)	P-VII	3	3	--	25	25	2
4.	Pharmaceutical Chemistry (P.Chem654)	P-VIII	3	3	--	25	25	2
5.	Biotechnology (Bio.Tech655)	P-VI	3	3	--	25	25	2
6.	Biotechnology (Bio.Tech656)	P-VII	3	3	--	25	25	2
Total							450	30

Optional-I Chemistry

Paper-VII Chemistry (Chem 601)

U-1 (Inorganic Chemistry) 11 hrs

1.1 :Stability of metal complexes: Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method. **3h**

1.2: Hard and soft acids bases (HSAB): Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of a reaction. . **4h**

1.3;Bioinorganic chemistry: Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride (Cl⁻). Metalloporphyrins – hemoglobin, structure and function, Chlorophyll, structure and role in photosynthesis. . **4h**

U-2 (Organic Chemistry) 12 h

2.1 Carbohydrates 7 h

Introduction: Classification and nomenclature – classification into mono, oligo and polysacchrides into pentoses, hexoses etc. into aldoses and ketoses.

Monosaccharides: All discussion to be confined to (+) glucose as an example of aldo hexoses and (-) fructose as example of ketohexoses. Chemical properties and structural elucidation:

Evidences for straight chain pentahydroxy aldehyde structure (Acetylation, reduction to n- hexane, cyanohydrin formation, reduction of Tollen's and Fehling's reagents and oxidation to gluconic and saccharic acids). Number of optically active, isomers possible for the structure, configuration of glucose based on D-glycealdehyde as primary standard (No proof for configuration is required). Evidence for cyclic structure of glucose (some negative aldehyde tests and mutarotation). Cyclic structure of glucose: Proposition of cyclic structure (Pyranose structure, anomeric Carbon and anomers). Proof for the ring size (methylation, hydrolysis and oxidation reactions). Different ways of writing pyranose structure (Haworth formula and chair conformational formula). Structure of fructose: Evidence of 2 – ketohexose structure (formation of penta acetate, formation of cyanohydrin its hydrolysis and reduction by HI to give 2-Carboxy-n-hexane) Same osazone formation from glucose and fructose, Hydrogen bonding in osazones, cyclic structure for fructose (Furanose structure and Haworth formula).

Inter Conversion of Monosaccharides: Aldopentose to aldo hexose – eg: Arabinose to D-glucose, D- mannose (kiliani – Fischer method). Epimers, Epimerisation- Lobry de bruyn van Ekenstein rearrangement. Aldohexose – Aldopentose eg: D-glucose to D-arabinose by Ruff's degradation. Aldohexose(+) (glucose) to ketohexose (-)(fructose) and Ketohexose(Fructose) to aldohexose (Glucose).

2.2 Amino acids and proteins 5 h

Introduction: Definition of Amino Acids, classification of Amino acids into alpha, beta and gama amino acids. Natural and essential amino acids – definition and examples,

classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, valine and Leucine) by following methods: a) From halogenated Carboxylic acid b) Malonic ester synthesis c) strecker's synthesis. Physical properties: Optical activity of naturally occurring amino acids: L – configuration, irrespective of sign of rotation. Zwitter ion structure – salt like character, solubility, melting points, amphoteric character, definition of isoelectric point. Chemical properties: General reactions due to amino and carboxyl groups – Lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins, peptide synthesis.

U-3 Physical chemistry

13Hrs

1.1 Thermodynamics- I

Energy, work and heat units, mechanical equivalent of heat. definition of system, surroundings. I law of thermodynamics statement- various forms mathematical expression. Thermodynamic quantities- extensive properties and intensive properties, state function, path functions energy as a state function, and exact differential of expansion and heat absorbed as path function. Expression for work of expansion, sign convention problems on I law. Heat changes at constant pressure and heat changes at constant volume. Enthalpy. Heat capacities at constant pressure and constant volume. Derivation $C_p - C_v = R$. Isothermal adiabatic processes. Reversible and irreversible processes. Reversible change and maximum work. Derivation of expression for maximum work for isothermal reversible process. Problems. Internal energy of an ideal gas. Joules experiment and Joule-Thompson coefficient. Adiabatic changes in ideal gas derivation of equation, $PV^\gamma = \text{constant}$. P-V curves for isothermal and adiabatic processes. Heat of a reaction at constant volume and at constant pressure, relation between ΔH and ΔV . Variation of heat of reaction with temperature. Kirchoff's equation and problems. Limitations of I law and need for II law. Statement of II law of thermodynamics. Cyclic process. Heat engine, Carnot's theorem, Carnot's cycle. Derivation of efficiency of heat engine problems. Thermodynamic scale of temperature.

U-4 General Chemistry

12h

4.1 Inorganic Reaction mechanisms.

4h

Classification of reactions- dissociation and association, electron transfer, elimination, chain and polymerisation reaction with suitable examples.

Substitution reaction SN_1 & SN_2 , Unimolecular and Bimolecular nucleophilic substitution reactions with suitable examples.

Concept lability and inertness of the complexes. Factors effecting lability of the complexes.

Hydrolysis of silicon halides and phosphorous oxides.

4.2: Introductory treatment to Pericyclic Reactions:

4 h

Concerted reactions, Molecular orbitals, Symmetry properties HOMO, LUMO, Thermal and photochemical pericyclic reactions. Types of pericyclic reactions – electrocyclic, cycloaddition and sigmatropic reactions – one example each.

4.3: Thermodynamics-II

4h

Entropy: Definition from Carnot's cycle. Entropy as a state function. Entropy as a measure of disorder. Sign of entropy change for spontaneous and non-spontaneous processes. Entropy changes in i) Reversible isothermal process, ii) reversible adiabatic process, iii) phase change, iv) reversible change of state of an ideal gas. Problems. Free energy Gibbs's function (G) and Helmholtz's function (A) as thermodynamic quantities. Concept of maximum work and net work ΔG as criteria for spontaneity. Derivation of equation $\Delta G = \Delta H - T\Delta S$. significance of the equation. Variation of G with pressure and temperature.

Books suggested &

1. Modern Inorganic Chemistry by William L. Jolly
2. Reaction Mechanisms of Metal Complexes by Robert W. Hay
3. Inorganic Reaction Mechanisms by Basalo and Pearson
4. Inorganic Reaction Mechanism by M.L. Tobe and John Burgers
5. Text book of organic chemistry by Morrison and Boyd
6. Text book of organic chemistry by Graham solomons
7. Text book of organic chemistry by Bruice yuranis Powla
8. Text book of organic chemistry by Sony
9. Principles of Physical Chemistry by Soni and Dharmahara.
10. Text book of Physical Chemistry by Puri and Sharma
11. Text book of Physical Chemistry by R.P Verma.
12. Physical Chemistry by Atkins

References:

1. Principles of Inorganic chemistry by Puri, Sharma, and Kalia
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn
3. Basic Inorganic Chemistry by F.A. Cotton, G. Williams
4. Principles of Inorganic Chemistry G.S. Manku
5. Theoretical Inorganic Chemistry by Day and Selbin
6. Inorganic Chemistry by E.S. Gilreath
7. Inorganic Chemistry Principles of structure and reactivity by James E. Huhey, E.A. Keiter and R.L. Keiter 4th edn
8. Chemistry of the Elements by n.n. Green Wood and A. Earnshaw
Pergamon Press 1989
9. Inorganic Chemistry by Shriver and Atkins 3rd edn.
10. General Organic chemistry by Sachin kumar Ghosh
11. Elements of Physical Chemistry by Lewis Glasstone

Optional subject-I: Chemistry

Paper-VIII Chemistry (Chem 602)

U-1 : Introduction to Green chemistry 12 hrs

1. Introduction: Definition.
2. Basic principles: Prevention of waste, maximum incorporation of reactants, Prevention or minimization of Hazardous products. Designing safe chemicals,

Energy requirements for synthesis, Selection of solvents, Selection of starting materials, Use of protecting groups, Use of catalysts, Biodegradable products.

3. Application of Green Chemistry:

- a) Green Reagents: Poly NBS, Di Methyl Carbamate
- b) Green catalyst: Use of clay as catalyst in Acylation reaction.
- c) Microwave induced synthesis: Introduction.
- eg:- Hydrolysis of Benzyl chloride, Oxidation of toluene & Esterification.
- d) Ultra sound assisted Green Synthesis: Introduction.
eg:- Cannizzaro reaction, Saponification.
Biocatalysed Green Synthesis: Synthesis of Semi synthetic penicillin.
- e) Aqueous Phase Reactions: Diels- Alder reaction.
- f) Organic Synthesis in solid state: Dehydration of Alcohols.
Bromination and Nitration of aromatic compounds.

4. Synthesis of drugs involving basic principles of Green Chemistry:

eg :- Ibuprofen, Paracetamol.

U-2 Quantum Chemistry

12hrs

The origin of Quantum mechanics. The failures of classical physics – Black Body radiation, Planck distribution, Heat capacities, Atomic and molecular spectra. Wave particle duality- The principle nature of Electromagnetic radiation (Photoelectric effect). The wave character of particles (DeBroglie's equation). The diffraction of electrons. The dynamics of microscopic function- The Schrodinger equation, the Born interpretation of the wave equation (normalisation and quantisation).

Quantum mechanical principles- The information in wave function (the probability density, Eigen values, Eigen function. Operators, Super position and expectation values. The Uncertainty principle.

U-3 Physical chemistry

12 hrs

3.1: Catalysis

8h

Homogeneous and heterogeneous catalysis, comparison with examples. Kinetics of specific acid catalyzed reactions, inversion of cane sugar. Kinetics of specific base catalyzed reactions, base catalyzed conversion of acetone to diacetone alcohol. Acid and base catalyzed reactions- hydrolysis of esters, mutarotation of glucose. Catalytic activity at surfaces. Mechanisms of heterogeneous catalysis. Langmuir-Hinshelwood mechanism.

Enzyme catalysis: Classification, characteristics of enzyme catalysis. Kinetics of enzyme catalyzed reactions-Michaelis Menton law, significance of Michaelis constant (K_m) and maximum velocity (V_{max}). Factors affecting enzyme catalysis- effect of temperature, pH, concentration and inhibitor. Catalytic efficiency. Mechanism of oxidation of ethanol by alcohol dehydrogenase.

3.2 Nanomaterials

4 hrs

Nano structured materials – Definition, description of graphite, fullerenes, carbon nano tubes. Production of carbon nano tubes – arc discharge, pyrolysis, laser vaporization and electrolysis methods. Mechanical and electronic properties of carbon nano tubes (CNT). Nano material advantage, importance in technological applications

U-4 General chemistry

11h

4.1 Quantitative Analysis by Spectrophotometry

9 hrs

General features of absorption spectroscopy. Terms used - transmittance, absorbance, molar absorptivity.

Fundamental laws of absorption-Lamberts law, Beer's law, combined lamberts –beers law; Deviation from the law,

Instrumentation –Single and double beam spectrophotometers. Application of Beer Lambert's law for qualitative analysis. i. Determination of Fe(III) using thiocyanate ii. Determination of manganese in $KMnO_4$

iii. Determination of Manganese in Manganous sulphate (in steel)

iv. Determination of the composition of a complex by Job's continuous method and Mole ratio method.

4.2 Water Analysis :

2hrs

Hardness of water, soft water, Units of hardness of water. Softening of water Zeolite Process (deionisation of water), Chemical Oxygen Demand and Biological Oxygen Demand.

Books suggested :

1. New trends in Green Chemistry by Ahluwalia
2. Principles of Physical Chemistry by Soni and Dharmahara.
3. Text book of Physical Chemistry by Puri and Sharma
4. Text book of Physical Chemistry by R.P Verma.
5. Physical Chemistry by Atkins
6. Quantum chemistry by A.K.Chandra

Laboratory Course in Organic Chemistry (3h/week)

45h

Paper-VII (Organic) (Chem 651)

Qualitative Analysis: Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives. (carboxylic acids, phenols, amines, carbonyl compounds, amides, esters, nitrohydrocarbon, polynuclear hydrocarbon, carbohydrates and urea) Demonstration of extraelemental test for N, X & S.

Thin Layer Chromatography: Determination of R_f Values and identification of organic compounds: Preparation and separation of 2,4-dinitrophenyl hydrazones of acetone and 2-butanone using toluene and light petroleum (40:60).

Laboratory course for physical chemistry Paper- VIII (Physical) (Chem 652)

45 Hrs (3 hr/week)

Non instrumentation:

1. Determination of specific reaction rate of the hydrolysis of methyl/ethyl acetate catalyzed by hydrogen ion at room temperature.
2. Determination of rate of decomposition of hydrogen peroxide catalyzed by Fe^{+3} ion.
3. Determination of order of saponification of ethyl acetate.

Instrumentation:

4. Determination of strength of hydrochloric acid by a potentiometric titration using sodium hydroxide.
5. Determination of red-ox potential of $\text{Fe}^{2+}/\text{Fe}^{3+}$ by potentiometric titration using ferrous ammonium sulphate
6. Verification of Beer's law using potassium permanganate / potassium dichromate and determination of concentration of the given solution.
7. Determination of dissociation constant of acetic acid by a pH- metric titration

Optional II- Pharmaceutical Chemistry

Paper-VII Medicinal Chemistry (P.Chem 603)

U-25: Basic concepts of Drug activity

U-26: Drugs acting on Central nervous system

U-27: Drugs acting on Peripheral nervous system

U-28: Drugs acting on Cardiovascular system

U-25: Basic concepts of Drug activity:

15hrs

Introduction, factors affecting biological activity, physico chemical properties-ionization, partition coefficient, hydrogen bonding, isomerism, chemical structural aspects, resonance and inductive effects. Oxidation reduction potential, types of bonding, isosterism, bioisosterism, molecular dimensions and interatomic distances. Theories of drug activity, occupancy theory, rate theory, induced fit theory, molecular perturbation theory. Receptor concept of drug activity.

Introduction to molecular targets- lipids, carbohydrates, proteins and nucleosides. A brief introduction to the architecture of the cell- Human Cell structure, Cell wall, cell membrane - membrane lipids, membrane proteins, membrane carbohydrates.

U-26: Drugs acting on Central nervous system:

15hrs

Introduction, Neurochemical transmission in the nervous system. Classification into CNS and Peripheral nervous drugs.

(A study of the following classes of drugs including introduction, classification, structures, mechanism of action and SAR.)

CNS depressants: General anaesthetics: Haloethanes (inhalation anesthetic), Thiopentone (intravenous anesthetic) **Anxiolytics, Hypnotics & Sedatives:** Diazepam, Alprazolam.

Antipsychotic drugs: Chlorpromazine and Clozapine

Anti convulsants or Antiepileptic drugs: Phenytoin, Phenobarbitone.

CNS Stimulants: Analeptics: Nikethamide. **Psychomotor stimulants:** Amphetamine.

Antidepressants: Imipramine, Fluoxetine

Neurodegenerative disorders: Introduction, mechanism of neuronal death. Structure and mode of action of- **Alzheimer's disease:** Donepezil, **Parkinson disease:** Levodopa, **Huntington's disease:** Haloperidol. Drug dependence and drug abuse. **Serotonin agonists:** serotonin, **Serotonin antagonists:** metaclopramide

U-27: Drugs acting on Autonomic nervous system: 15hrs

Definition and examples of agonists and antagonists, neurotransmitters and Adrenergic and Cholinergic receptors.

(i) **Drugs effecting adrenergic neurotransmission:** Biosynthesis and inactivation of adrenergic neurotransmitters. Adrenergic receptors and their classification into α & β - sub types.

a) Drugs acting on biosynthesis of

adrenergic neurotransmitters - metyrosin.

b) Drugs effecting catecholamine storage and release. Eg. Reserpine (structure only) **c) α -**

Adrenergic receptor agonists: norepinephrine, epinephrine and methyl dopa. **d) α -Adrenergic receptor antagonists:** Structural formulae of APC and Benextramine. Synthesis of phenoxy benzamine, terazosin and prazosin. **e) β - Adrenergic receptor agonist:** Dobutamine, salbutamol, terbutalin. **f) β -Adrenergic receptor antagonists:** propranolol, metoprolol and atenolol.

i) Cholinergic receptors: Biosynthesis and inactivation of acetyl choline. Cholinergic receptors and their classification into muscarinic and nicotinic

receptors. **a) Cholinergic agonists:** Acetyl choline, carbachol and

bethanecol. **b) Cholinesterase inhibitors:** Physostigmine and structure of neostigmine. **c)**

Cholinergic antagonists: Muscarinic antagonists - atropine (only structure), Ganglionic antagonists-nicotine, Neuromuscular antagonists- tubocurarine and succinylcholine

U-28: Drugs acting on Cardiovascular system:

15hrs

Introduction, types of cardiovascular diseases. Structure mode of action of –**Anti hypertensive drugs-** Hypertension and its classification eg: ACE inhibitors-eg: captopril, enalapril.

β -blockers- Propranolol, Atenolol. **Ca²⁺channel blockers-** Nifedipine, Diltiazem. α -

Adrenoreceptor stimulant: Clonidine, α - Adrenoreceptor blocking agent- Prazocin **Antianginal**

drugs eg. – Nitroglycerine, Amoldepine **Anti-arrhythmics:** Introduction, mechanism of arrhythmias, classification of anti arrhythmic drugs, Class-I Quinidine (Procanamide), Class-II eg: Lidocaine, Class-III: Propranolol, metoprolol, Class-IV Bretylium, Class-Veg: Verapamil

Cardiotonic drugs. eg: digitoxin, digoxin & dobutamine. **Anticoagulants-** blood clotting, its prevention & lysis. Structure and mode of action of Heparin and coumarols (warfarin and dicoumarol).

Thrombolytic drugs: streptokinase, urokinase. **Cyclooxygenase inhibitors:**

Aspirin, **Prostacyclins:** Carbocyclin, **Hypolipidemic drugs:** Introduction to lipoprotein metabolism, structure and mode of action of Clofibrate, Lovastatin, Simvastatin.

Recommended text books:

1. Introduction to Medicinal chemistry. By Patrick.
2. Introduction to drug design. By Silvermann

3. Comprehensive medicinal chemistry. Vol 1-5 By Hanzsch.
4. Principles of medicinal chemistry. By William Foye
5. Biochemical approach to medicinal chemistry. By Thomas Nogrady.
6. Textbook of organic medicinal and pharmaceutical chemistry. By Delgado and William

References:

- 5) Introduction to medicinal chemistry. How drugs act and why. By Alex Gringauz.
- 6) Hand book of pharmaceuticals. By Shenoy and Shenoy.
- 7) Medicinal chemistry: an introduction. By Gareth Thomas.
- 8) Pharmacology. By Rang, Dale and Ritter.
- 9) Pharmacology for chemists. By Joseph G. Cannon.
- 10) Modern pharmacology with clinical applications. By Charles. Craig and Robert. E. Sittel.
- 11) Pharmacology by Lippincott
- 12) Introduction to pharmacology by Rang.
- 13) Burger's medicinal chemistry and drug discovery. By Manfred E. Wolf.

Paper-VIII Pharmaceutical analysis-II (P.Chem 604)

U-29: Electrochemical analysis

U-30: Amperometry, Polarography & miscellaneous methods

U-31: Electro gravimetry

U-32: XRD & Thermal methods of analysis

U-29: Electrochemical analysis: 15hrs

Theory, measurement of pH, reference electrodes, calomel electrode, silver-silver chloride electrode, mercury(I) sulphate electrode, salt bridges. Indicator electrode-Hydrogen, glass, redox electrodes. Ion selective electrode- characteristics and usage, response & limits of detection, interference, pH effects. Methods of measurement and potentiometric titrations.

eg. Nitrazepam and allopurinol. (working of problems wherever necessary)

Conductometry : Principles and theoretical aspects – conductance, Equivalent and Molar conductance, effect of dilution on conductance, conductivity of water, cell constant, conductivity cell, Measurement of conductivity, Wheatstone bridge principle, conductimetric titrations and applications. (examples)

U-30: Amperometry & miscellaneous methods: 15hrs

Amperometry: Introduction, theory, instrumentation (dropping mercury electrode), rotating platinum electrode, twin polarised microelectrodes) eg. Procainamide hydrochloride. Miscellaneous methods: i) Diazotization (sodium nitrite titration) Theory eg. Isocarboxazid. ii) Karl

Fischer method for determination of water-Theory, instrumentation eg.Prednisolone sodium phosphite. iii) Tetrazolium assay of steroids- Theory, eg.Hydrocortisone acetate.

U-31: Electro gravimetry

15hrs

Electrogravimetry and Polarography: Principles and theoretical aspects; current – voltage curve, different currents, half wave potential, Ilkovic equation. Polarography: Theory, current, voltage, curve, half wave potential, instrumentation, applications. Instrumentation – Polarographic setup, polarographic run
Applications – Qualitative and Quantitative analysis.

U-32: XRD & Thermal methods of analysis:

15hrs

X-ray Diffraction studies: Polymorphism, Weiss coefficients, Miller indices, Bragg's equation. Experimental methods- the rotating crystal method, oscillating crystal method, powder method, indexing the reflections, systemic absences and applications.
Thermal methods: Thermogravimetry- Theory, Instrumentation, Methodology and applications. Differential thermal analysis- theory, Instrumentation, Methodology and applications. Thermometric titrations- Theory, Instrumentation, Methodology and applications. Differential scanning calorimetry - Theory, Instrumentation, Methodology and applications.

Recommended text books:

1. Vogel's text book of quantitative chemical analysis
2. Quantitative analysis by Day & Underwood
3. Pharmaceutical analysis By Chapman
2. Pharmaceutical analysis By Ashtoshkar

References

1. Practical pharmaceutical chemistry. By A.H. Backette, J.B. Stenlake.
2. British Pharmacopoeia vol I,II
3. Indian Pharmacopoeia vol I,II
4. Fundamentals of analytical chemistry. By Skoog and West.
5. Pharmaceutical analysis. By Takeru, Higuchi
6. Pharmaceutical analysis By David G. Watson
7. Analytical chemistry by open learning by Clive Watson
8. Physical chemistry by Atkins
9. Physical chemistry by Glasstone
10. Solid state chemistry by West
11. Instrumental methods of analysis by Willard

Laboratory

Paper-VII : Medicinal chemistry-I (P.Chem 653)

A. Colour reactions of the following pharmaceuticals: Aspirin, Isoniazid, Analgin, Paracetamol, Ascorbic acid, Methylsalicylate,, Dichlorophen, cholesterol and quinine.

B. Synthesis of organic pharmaceuticals and intermediates:

Acetanilide (Acetylation), p-Bromoacetanilide (Bromination), p-Bromoaniline (Hydrolysis), 2,4,6 – Tribromoaniline (Bromination) , 1,3,5 – Tribromobenzene (Deamination), Aspirin (Acetylation), 7-Hydroxy – 4 – methyl coumarin (condensation), Anthracene-Maleic anhydride adduct (Diels – Alder reaction), Hippuric acid (Benzoylation), m-Dinitrobenzene (Nitration), m-Nitroaniline (Partial reduction)

**Paper—VIII: Pharmaceutical analysis-III (P.Chem 654)
(INSTRUMENTAL METHODS OF ANALYSIS)**

LIST OF EXPERIMENTS:

1. Colorimetric estimation of Ascorbic acid
2. Colorimetric estimation of dextrose in dextrose injection
3. Conductometric assay of pharmaceuticals
4. Determination of sulphate or chloride ions by turbidimetry and Nephelometry.
5. Potentiometric determination of equivalence point.
6. Conductimetric titration.
7. Determination of concentration of Ions by Polarography.
8. Determination of concentration of Ions by Specific – Ion Electrode.
9. Experiments based on Electrophoresis.
10. Determination of moisture content of a drug by using Karl Fischer titrator.

Recommended text books:

1. Vogel's text book of quantitative chemical analysis
2. Pharmaceutical analysis By Ashtoshkar
3. Practical manual in organic Chemistry by Manskee
4. Practical manual in organic Chemistry by Todd

Optional-III Biotechnology

Paper VII – Animal and Plant Biotechnology (Bio.Tech605)

U-1 Animal Biotechnology

- 1.1 Introduction to animal biotechnology
- 1.2 Principles of animal cell culture – culture vessels
- 1.3 Cell culture media preparation, sterilization, types of cultures

- 1.4 Establishment and preservation of cell lines
- 1.5 Explants and cell disaggregation
- 1.6 Culture of cells and tissues (including Stem cells and their application)

U-2 Methods of Gene Transfer and Production of Transgenics

- 2.1 *In vitro* fertilization and embryo transfer technology
- 2.2 Methods of gene transfer – Microinjection and viral mediated gene transfer techniques
- 2.3 Production of transgenic animals and molecular pharming
- 2.4 Principles of *Ex vivo* and *In vivo* gene therapy.

U-3 Plant Biotechnology

- 3.1 Composition of media (Murashige and Skoog's and Gamborg's only)
Preparation of media and methods of sterilizations
- 3.2 Role of plant growth regulators in differentiation
- 3.3 Induction of callus
- 3.4 Meristem culture and production of virus free plants
- 3.5 Clonal propagation of plants on a commercial scale (Somatic embryogenesis and organogenesis).

U-4 Bioreactors and Mass Cultivation of Cells

- 4.1 Mass cultivation of cell cultures and process engineering – Batch and Continuous Cultures.
- 4.2 Different types of Bioreactors – Advantages and disadvantages
- 4.2 Production of commercially useful compounds by plant cell culture
- 4.3 Methods of gene transfer techniques (*Agrobacterium*, Microprojectile bombardment)
- 4.4 Applications of recombinant DNA technology in agriculture
- 4.5 Production of therapeutic molecules and proteins from transgenic plants

Practicals (Bio.Tech651)

Preparation of media, and initiation of callus from any one selected plant species

Micropropagation of plants (any one)

Preparation of synthetic seeds

Cell disaggregation and cell counting

Cytotoxicity of the cells using the dye MTT method

Recommended Books

1. Strategies in Transgenic Animal Sciences - By Glemn M.M. and James M. Robl ASM Press 2000.

2. Practical Biotechnology – Methods and Protocols - By S. Janarthanan and S. Vincent (Universities Press)
3. Animal Cells as Bioreactors - By Terence Gartoright, Cambridge Univ Press
4. Molecular Biotechnology - By Chinnarayappa (Universities Press)
5. Principles and Practice of Animal Tissue Culture - By Sudha Gangal (Universities Press)
6. Introduction to Veterinary Genetics - By F.W. Nicholas, Oxford University Press.
7. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
8. Biotechnology -By H.J. Rehm and G. Reed Vol-1-86 VIH Publications, Germany
9. Guide for the care and use of lab animals National Academy Press.
10. Introduction to Biotechnology - By P.K. Gupta
11. Frontiers of Plant Tissue Culture - By T.A. Thorpe
12. Plant Tissue Culture – Theory and Practice - By S.S. Bhojwani and M.K. Razdan
13. Biotechnology – By U. Satyanarayana
14. Plant Biotechnology New Products and Applications - By J. Hammond, P. McGarvey, and V. Yusibov
15. Plant Tissue Culture – Basic and Applied - By Timir Baran Jha and B. Ghosh
16. Essentials of Biotechnology for Students - By Satya N. Das
17. Plant Tissue Culture - By Kalyan Kumar De

Paper VIII – Industrial and Environmental Biotechnology(Bio.Tech606)

U-1 Industrial Biotechnology – I

- 1.1 Introduction to industrial biotechnology.
- 1.2 Primary and secondary metabolic products of microorganisms
- 1.3 Screening and isolation and preservation of industrial microorganisms
- 1.4 Principles of Fermentation technology
- 1.5 Commercial production of fuels and chemicals by microbial fermentations

U-2 Industrial Biotechnology – II

- 2.1 Fermentative production of microbial enzymes (amylases, proteases), and antibiotics
- 2.2 Fermentative production of foods and dairy products
- 2.3 Animal cells as bioreactors; characteristics of bioreactors, expression and over - production of targeted proteins – human growth hormones – production of and – interferons, monoclonal antibodies
- 2.4 Good manufacturing practices, Biosafety issues, Bioethics

U-3 Environmental Biotechnology

- 3.1 Introduction to environmental biotechnology
- 3.2 Renewable and non-renewable energy resources
- 3.3 Conventional energy sources and their impact on environmental

3.4 Non-conventional fuels and their impact on environment (biogas, bioethanol, microbial hydrogen production)

3.5 Microbiological quality of milk, food and water

U-4 Bioremediation and Environmental Clean Up

4.1 Microbiological treatment of municipal and industrial effluents

4.2 Microbial degradation of pesticides and toxic chemicals

4.3 Biopesticides and Biofertilizers (Nitrogen fixing, phosphate solubilizing microorganisms)

4.4 Microbial ore leaching

4.5 Introduction to Bioremediation

Practicals (Biotech652)

1. Production of wine using common yeast
2. Production of hydrogen or biogas using cow/cattle dung
3. Isolation of microbes from soil or industrial effluents
4. Preparation of media and culture of animal cells/tissues
5. Estimation of BOD in water samples
6. Production of alcohol by fermentation and Estimation of alcohol by colorimetry
7. Production of Biofertilizers (*Azolla*)
8. Growth curves of bacteria, Measurement of growth in liquid cultures
9. Quality testing of milk by MBRT

Recommended Books

1. Biogas Technology - By B.T. Nijaguna
2. Biotechnology – I - By R.S. Setty and G.R. Veena
3. Biotechnology – II - By R.S. Setty and V. Sreekrishna
4. Introduction to Plant Tissue Culture - By M.K. Razdan (Oxford and IBH Publishing Company, New Delhi)
5. Introduction to Plant Biotechnology - By H.S. Chawla (Oxford and IBH Publishing Comp., New Delhi)
6. Biotechnology - By K. Trehan
7. Industrial Microbiology - By L.E. Casida
8. Food Microbiology - By M.R. Adams and M.O. Moss
9. Bioethics – Readings and Cases - By B.A. Brody and H. T. Engelhardt. Jr. (Pearson Education)
10. Biotechnology, IPRs and Biodiversity - By M.B. Rao and Manjula Guru (Pearson Education)
11. Bioprocess Engineering - By Shuler (Pearson Education)
12. Essentials of Biotechnology - By Irfan Ali Khan and Atiya Khanum (Ukaaz Publications)
13. Gene, Genomics and Genetic Engineering - By Irfan Ali Khan and Atiya Khanum (Ukaaz Publications).

Mahatma Gandhi University, Nalgonda
DEPARTMENT OF CHEMISTRY & PHARMACEUTICAL SCIENCES
M.Sc.5Yr Integrated Pharmaceutical Chemistry CBCS Syllabus
(Effective for students admitted from academic year 2015-2016 for Campus College)
[UNDER RESTRUCTURED CBCS Scheme]
(Revised in the P.G. BOS meeting held on 15 -06-18)

Semester-VII

S.No	Subject	Paper	Teaching hrs/week (Theory)	Examination hrs	Internal marks	Final Exam marks	Total marks	Credits
1.	Pharmaceutical Chemistry (P.Chem701)	P-IX	4	3	20	80	100	4
2.	Pharmaceutical Chemistry (P.Chem702)	P-X	4	3	20	80	100	4
3.	Pharmaceutical Chemistry (P.Chem703)	P-XI	4	3	20	80	100	4
4.	Pharmaceutical Chemistry (P.Chem704)	P-XII	4	3	20	80	100	4
		Practical classes						
1.	Pharmaceutical Chemistry (P.Chem751)	P-IX	6	6	-	60	60	4
2.	Pharmaceutical Chemistry (P.Chem 752)	P-X	6	6	--	60	60	4
3.	Pharmaceutical Chemistry (753)	P-XI	6	6	--	60	60	4
4.	Pharmaceutical Chemistry (P.Chem 754) Seminars & viva voce	P-XII	2	-	-	20	20	1
Total							600	29

Semester-VII

Paper-IX: Advanced Heterocyclics

(P.Chem 701)

U-33: Fused five membered Heterocyclics:

U-34: Diazines

U-35: Fused six membered Heterocyclics

U-36: Nucleic acids:

U-33: Fused five membered Heterocyclics:

15hrs

Structure, reactivity and synthesis of Benzofurans, Indole and Benzothiophenes.
Synthesis of Indole based pharmaceutical(example).

U-34: Diazines

15hrs

Structure and nomenclature of diazines. Reactions (with electrophiles, nucleophiles and oxidizing agents) and synthesis (One method only) of Pyrimidine, Pyridazine and Pyrazine. One example of pharmaceutical for each class (structure and pharmacological activity only).

U-35: Fused six membered Heterocyclics

15hrs

Quinoline: Synthesis-Skraup & Combes synthesis and reactions with electrophiles, nucleophiles and oxidizing agents, and reducing agents.. Structures of Quinine and chloroquine .
Isoquinoline: Synthesis-Bischler –Napieralski synthesis, Pictet –Splenger synthesis, and reactions with electrophiles, nucleophiles and oxidizing agents, and reducing agents. Structures of Papaverine.
Acridine and Carbazole- reactivity and synthesis Structure of Proflavin, 9-amino acridine)

U-36: Nucleic acids:

15hrs

Structure of the bases- Adenine, Thyamine, Guanine ,Uracil and cytosine. Structure and synthesis of nucleosides and nucleotides. Structure of DNA and RNA. Conformational structures of nucleic acids. Synthesis of oligonucleotides,

Recommended text books:

- 2.Heterocyclic chemistry by Joule and Smith
- 3.Heterocyclic chemistry by Acheson
- 4.Heterocyclic chemistry by Bansal
- 5.Biochemistry. By Lehninger.

References:

- 1.Biochemistry. By Stryer.
- 2.Biochemistry. By Rastogi.
- 3.Biochemistry. By Chatwal.
- 4.Biochemistry. By Well.
- 5.Organic Chemistry by McMurray
- 6.The Biochemistry of the Nucleic acids By Adams,Knowler and Leader

U-37: Diuretics and Hypoglycemic agents

U-38: Local anesthetics, Narcotic analgesics and NSAIDS

U-39: Gastrointestinal agents & Chemotherapeutics-I

U-40: Chemotherapeutics-II

*A study of the following classes of drugs including introduction, classification, structures, mechanism of action and SAR.

U-37: Diuretics and Hypoglycemic agents:

15hrs

Diuretics: introduction to anatomy, physiology and functioning of nephron, classification of diuretics. Structure and mode of action of: Site-1 Diuretics: Carbonic anhydrase inhibitors- Acetazolamide, methazolamide. Site-2 Diuretics: Furosemide, Ethacrynic acid. Site-3 Diuretics: Hydrochlorothiazide, Clopamide. Site-4 Diuretics: Spiranolactone, Amloride and Miscellaneous Diuretics: Mannitol and Theophyllin.

Hypoglycemic agents: Introduction pancreatic islet hormones. Secretion of Insulin and its mechanism of action. Control of blood glucose. Types of Diabetic mellitus. Structure and mode of action of 1. Drugs used in diabetics- Insulin 2. Oral hypoglycemic agents: Metformin, Tolbutamide, Gliclazide.

Drugs affecting Thyroid function: Introduction to Thyroid functions , structure and mode of action of Methimazole, Propylthiouracil.

U-38: Local anesthetics, Narcotic analgesics and NSAIDS

15hrs

Local anesthetics: Introduction, sodium and potassium channels of excitable membranes. Structure and mechanism of action of Tetracaine, Benzocaine, Lidocaine , xylocaine and Bupiracaine.

Narcotic analgeics: Introduction, characteristic features of Opioids, types of Opioids receptors, classification fo narcotic anelgisics. Structure and mode of action of Morphine, Dextromethorphan, Metazocin, Pethidine, Methadone.

Narcotic antagonists: Nalorphine hydrochloride, Naloxone hydrochloride

NSAIDS (Nonsteroidal anti inflammatory drugs): Introduction, definition of inflammation, classification of NSAIDS. Structure, mode of action of Aspirin, Ibuprofen, Naproxen, Diclofenac, Indomethacin and Phenylbutazone.

U-39: Gastrointestinal agents & Chemotherapeutics-I:

15hrs

Gastrointestinal agents: Introduction to anatomy and brief physiology of gastrointestinal system and gastrointestinal disorders. Drugs which increase gastrointestinal motility-laxatives, motility stimulants-eg.metaclopramide, Drugs which decrease gastrointestinal motility-Anti

diarrhoeal drugs (eg. loperamide), Anti spasmodic drugs (eg. propantheline, dicyclomene).
Drugs used to dissolve gallstones-chenodeoxy cholic acid, ursodeoxy cholic acid. Inflammatory-
Bowel disease- Prednisolone. Antiemetic drugs- Domperidone, Ondasetron . Drugs used to treat
peptic ulcers-Antacids, omeprazole, cimetidine and ranitidine. Anti allergic drugs:
Diphenhydramine hydrochloride

U-40: Chemotherapeutics:

15hrs

Introduction to chemotherapy. Basic principles- Drug resistance, drug synergism.

Sulphonamides: Sulphamethoxazole, Sulphameter

Antimalarial drugs: Introduction, Etiology, classification. Structure and mode of action of
Quinine, Pamaquine, Chloroquine and Trmethoprim .

Anthelmintics: Introduction, classification, structure and mode of action of Di ethyl
Carbamazine, Albenazole, Praziquantel, Permethrin.

Antineoplastics agents: Introduction, cancer causing agents, tumor cell properties,
classification. Structure, mode of action of 1. Alkylating agents-Mechlorothiamine,
cyclophosphamide 2. Antimetabolites- 5-Fluro Uracil 3. **Antibiotics-** Daunorubicin,
Doxorubicin 4. Plant products- Taxol 5. Miscellaneous compounds- Cisplatin 6. Hormones-
Testolactones

Immunotherapy.

Antiviral drugs: Introduction, classification, structure, mode of action of Amantadine,
Acyclovir, AZT, and Methisazone

Antiprotozoal:

Anti tuberculars: Isonicotinic acid hydrazide and ethambutol

Anti leprotics : Dapsone

Antiamoebics : Metronidazole, Diloxanide furoate

Combination drugs for opportunistic infections:

Trimethoprim+ Sulphamethaoxazole, Pyrimethamine+ sulphadiazine and
Silver sulphadiazine+ Mafenide

Recommended text books:

II. Comprehensive medicinal chemistry. Vol 1-5 By Hanzsch.

III. Principles of medicinal chemistry. By William Foye

IV. Biochemical approach to medicinal chemistry. By Thomas Nogrady.

V. Textbook of organic medicinal and pharmaceutical chemistry. By Delgrado and
William

V. Introduction to Medicinal chemistry. By Patrick.

References:

- Introduction to medicinal chemistry. How drugs act and why. By Alex Gringauz.
- Hand book of pharmaceuticals. By Shenoy and Shenoy.
- Medicinal chemistry: an introduction. By Gareth Thomas.

Paper-XI: Spectroscopy-I

(P.Chem 703)

U-41: Advanced PMR

U-42: C¹³ NMR

U-43: 2D-NMR

U-44: Qualitative and quantitative applications of H^1 NMR, C^{13} NMR&2D NMR

U-41: Advanced PMR

15hrs

Application of PMR spectroscopy in structure determination. Electro negativity, Keto-enol tautomerism, proton exchange in alcohols, amines and carboxylic acids, hydrogen bonding, C-N rotation. Types of spectra – (Features of first order spectra).

AX, AX₂, AX₃, AMX and AB types. Vicinal, geminal, long range and virtual coupling. Coupling constants. Introduction to second order spectra. Methods to simplify complex spectra - Double resonance technique, deuterium exchange, chemical shift reagents and nuclear overhauser effect (nOe) (qualitative treatment only).

U-42: C^{13} NMR

15hrs

C^{13} NMR spectroscopy: Recording C^{13} NMR spectra -undecoupled, proton decoupled, off-resonance decoupled and selective proton decoupled spectra. C^{13} chemical shift data- structural, electronic and steric effects on chemical shifts. Coupling constants in C^{13} spectral editing techniques-INEPT, DEPT methods.

U-43: 2D NMR:

15hrs

Introduction to 2D NMR. Different types of 2D experiments- 2D-J resolved spectroscopy, correlation spectroscopy (COSY), HOMO COSY and HETERO COSY (HETCOR).

U-44: Qualitative and quantitative applications of H^1 NMR, C^{13} NMR&2D NMR 15hrs

Qualitative and quantitative applications of NMR: Proton NMR of H^1 NMR, C^{13} NMR & 2D NMR spectra of paracetamol, aspirin, salbutamol, benzocaine, phenacetin & clofibrate. Quantitative analysis of pharmaceuticals i) Aspirin-paracetamol-codiene tablets ii) Aspirin-paracetamol-caffeine tablets

Recommended text books:

1. NMR in Chemistry-A multinuclear introduction. By William Kemp
2. Spectroscopic identification of Organic Compounds. By Silverstein, Basseler & Morrill
3. Spectroscopic identification of Organic Compounds. By P.S.Kalsi
4. Organic Spectroscopy. By William Kemp

References:

1. NMR spectroscopy. By Grunther
2. Organic spectroscopy. By Fleming
3. Advances in NMR spectroscopy. By Saunders et al
4. Introduction to spectroscopy by Pavia
5. Pharmaceutical analysis by Watson
6. Practical pharmaceutical chemistry by Beckett & Stenlake

Paper-XII: Synthetic Pharmaceutical Chemistry(P.Chem 704)

U-45: Reagents in Pharmaceutical synthesis

U-46: Conformational isomerism

U-47: Strategies in Organic synthesis

U-48: Stereo selective synthesis & Chiral drugs

U-45: Reagents in Pharmaceutical synthesis:

15hrs

1.Reducing agents: catalytic hydrogenation, sodium borohydride, lithium aluminium hydride and sodium/alcohol. (Mention of modified Hydride reagents: Lithium borohydride, lithium diisopropyl amide, Sodium cyanoborohydride, sodium triacetoxy borohydride, Diisobutyl aluminium hydride). Application to the reduction of alkenes, alkynes, carbonyl and azo compounds.

Oxidizing agents: Sulfuric acid, Potassium permanganate, osmium tetroxide, chromium trioxide and peracids. Application to the oxidation of alkenes, alkynes, alcohols and carbonyl compounds with one example each.

Organo-metallic reagents – Preparation and application of the following in organic and pharmaceutical synthesis with mechanism- Grignard reagent, organo lithium, organo boron reagent (Hydroboration, reaction of organoborane in C-C bond formation), Organo silicon reagents & utility of trialkyl silyl halide, trialkyl silyl cyanide and trialkyl silyl triflate.

Protectable groups and reagents-Principles of protection of alcohols-ether, ester formation. Protection of amines- acetylation, benzylation, benzyloxy carbonyl and triphenyl methyl groups. Protection of carbonyl groups-acetal, ketal, 1,2-glycols and 1,2-dithioglycol formation

U-46: Conformational isomerism

15hrs

Study of conformations of acyclics- ethane, propane, n-butane. Population of conformers and torsional angles, conformations of haloalkanes, halohydrins and glycols. Conformational enantiomers and diastereomers. eg- butane 2,3-diol, ephedrine and Ψ -ephedrine. Study of conformations of cyclic molecules- cyclopropane, cyclobutane, cyclopentane, cyclohexane (mono, di-1,2-, 1,3- & 1,4-), decalins and hydrindanes. Conformational structures of decahydroquinoline, cholesterol, morphine, menthol and neomenthol. Conformational flexibility and multiple modes of biological effects of neurohormones. eg: Acetyl choline, epinephrine, histamine.

U-47: Strategies in Organic synthesis

15hrs

Introduction to organic synthesis. Target selection. The disconnection approach with examples - Terminology - definition of target molecule, functional group interconversion (FGI), disconnection product, disconnection, synthons, reagents, transform, and retrosynthesis. Chemoselectivity, regioselectivity and stereo selectivity. Synthetic tree - Linear and Convergent synthesis. Importance of order of events in organic synthesis - examples. One group C-X and two group C-X disconnections - examples. Reversal of polarity - cyclization reactions and amine synthesis.

Introduction to one group C-C disconnection: and two group disconnections. Examples. *Strategic bonds* - Definition. Criteria for disconnection of strategic bonds in carbocyclics. Application of these strategies to the synthesis of (+)-disparlure, Z-jasmone, retronecine and longifoline.

U-48: Stereo selective synthesis & Chiral drugs

15hrs

Selectivity in synthesis: Definition and explanation of following with examples Substrate selectivity, product selectivity. Substrate enantioselectivity and Diastereoselectivity, product enantioselectivity and Diastereoselectivity.

Topocity in molecules: Homotopic, enantiotopic and diastereotopic units. Explanation each based on substitution/addition and symmetric criteria with examples.

Prochirality: Nomenclature of prochiral Ligands and faces. Optical purity ee,de,method for estimation

Stereo selective reactions of carbonyl compounds:

1,2-Asymmetric induction –(1) Nucleophilic addition to carbonyl group with examples of addition of organometallic reagents and reduction with metal hydrides Cram's rule and its limitations. Felkin-Anh model,

(2) Enantio selective Aldol with chiral auxillary.

(3) α -alkylation reactions of chiral enolates using chiral auxillary Example Evan's oxazolidinone,S-prolinol

(4)Reduction with chiral LiAlH₄ (BINAL-H),chiral boron hydride (Alpineborane) CBS

Stereoselective reactions of alkenes. Asymmetric Diels-Alder reaction, Sharpless & Asymmetric Hydro Boration with IPCBH₂& IPC₂BH.

Recommended text books:

1. Hand Book of Reagents for organic synthesis. By Reich, Rigby
2. Stereochemistry : conformation and mechanism by P.S.Kalsi
3. Stereochemistry of carbon compounds by Eliel
4. Stereochemistry of organic compounds by Eliel
5. Stereochemistry through solved problems by Kalsi
6. Stereochemistry of organic compounds By Nasipuri
7. Chirotechnology by Sheldon
8. Guide book to Organic synthesis. By Mackie,Smith and Atkins
9. Organic synthesis. By Michael B.Smith

References:.

1. Asymmetric organic reactions. By Morrison and Moscher.
2. Asymmetric synthesis. By Nogradi.
3. Selectivity in organic synthesis. By Ward.
4. Stereo chemistry of organic compounds. By Eliel.
5. Top Drugs: Top synthetic routes. By John Saunders.
6. Hand book of reagents for organic synthesis. Auxallaries: By Coates.
7. Hand book of reagents for organic synthesis. Protecting groups: By Pearson.
8. Hand book of reagents for organic synthesis:oxidising & reducing agents. By Burk

Laboratory:

Paper-IX: Separation of Binary and ternary organic mixtures. (P.Chem 751)

Seperation and analysis of organic binary and ternary mixtures.

Paper-X: Synthesis Organic pharmaceuticals (P.Chem 752)

Synthesis of : Benzocaine (Anaesthetic), Antipyrine(Antipyretic), Barbituric acid from Diethyl Malonate.sulphonamide(antibacterial), 2-phenyl indole , Quinoxalinone, Isoniazid(Anti Tubercular), Benzylic acid rearrangement, Beckmann rearrangement and stereoselective reduction of ethyl acetoacetate by bakers yeast.), Azalactone (Cyclization), Phthalimide (amidation), Diphenyl hydantoin, Phenothiazine

Paper-XI: Drug Estimations (P.Chem 753)

Quantitative analysis- Estimation of 1. Assay of benzyl penicillin(iodometry) 2.Assay of phenyl butazone(acid-base) 3. Assay of bisacodyl (nonaqueous) 4.Assay of ethambutol(nonaqueous) 5Assay of adrenalin 6.Assay of morphine and atropine in a mixture 7.Assay of Sulphanilamide by diazatisation.8.Assay of Phenytoin 9.Assay of Phenacetin.10.Assay of metrinidazole 11.Assay of Chloroquine phosphate.

Paper-XII: Seminars& viva (P.Chem 754)

Recommended text books:

1. Vogel's text book of quantitative chemical analysis
2. Pharmaceutical analysis By Ashtoshkar
3. Practical manual in organic Chemistry by Manskee
4. Practical manual in organic Chemistry by Todd
5. Indian Pharmacopiea P-I& II

Mahatma Gandhi University, Nalgonda
DEPARTMENT OF CHEMISTRY & PHARMACEUTICAL SCIENCES
M.Sc.5Yr Integrated Pharmaceutical Chemistry CBCS Syllabus
(Effective for students admitted from academic year 2015-2016 for Campus College)
[UNDER RESTRUCTURED CBCS Scheme]
(Revised in the P.G. BOS meeting held on 15 -06-18)

Semester-VIII

S.No	Subject	Paper	Teaching hrs/week (Theory)	Examination hrs	Internal marks	Final Exam marks	Total marks	Credits
1.	Pharmaceutical Chemistry (P.Chem 801)	P-XIII	4	3	20	80	100	4
2.	Pharmaceutical Chemistry (P.Chem 802)	P-XIV	4	3	20	80	100	4
3.	Pharmaceutical Chemistry (P.Chem 803)	P-XV	4	3	20	80	100	4
4.	Pharmaceutical Chemistry (P.Chem 804)	P-XVI	4	3	20	80	100	4
		Practical classes						
1.	Pharmaceutical Chemistry (P.Chem 851)	P-XIII	6	6	-	60	60	4
2.	Pharmaceutical Chemistry (P.Chem 852)	P-XIV	6	6	--	60	60	4
3.	Pharmaceutical Chemistry (P.Chem 853)	P-XV	6	6	--	60	60	4
4.	Pharmaceutical Chemistry (P.Chem 854) Seminars & viva voce	P-XVI	2	-	-	20	20	1
Total							600	29

Semester-VIII

Paper-XIII: Spectroscopy-II(P.Chem 801)

Paper-XIV: Advanced chromatographic techniques(P.Chem 802)

Paper-XV: Medicinal Natural products(P.Chem 803)

Paper-XVI: Basics in Pharmacology(P.Chem 804)

Paper-XIII:Spectroscopy-II

(P.Chem 801)

U-49: Principles of Mass spectrometry

U-50: Applications of mass spectrometry to pharmaceuticals

**U-51: Qualitative and quantitative applications of IR and UV to
Pharmaceuticals.**

**U-52: Principles and pharmaceutical applications of AAS , AES and
Spectrofluorimetry**

U-49: Principles of Mass spectrometry

15hrs

Origin of spectrum, principles of EI mass spectrometer, types of fragments, odd electron containing neutral and charged species, Nitrogen rule, rotation between number of nitogens, odd and even mass and odd electron and even electron containing cations. Isotopic peaks, common mass fragmentation patterns organic compounds. Fragmentation of simple hydrocarbons, aromatic compounds, alcohols, carboxylic acids, esters & amides.

U-50: Applications of Mass spectrometry to pharmaceuticals

15hrs

McLafferty rearrangement, Retro-Diels-Alder fission, ortho effect, principles of ion production techniques-CI, Fast Atom Bombardment (FAB), Secondary Ion mass Spectrometry (SIMS). EI mass spectra of Limonene, codeine bupiracaine (α -cleavage), chloroquine, propranolol, famotidine, butorphanol. SIMS of 5-deoxy guanosyl monophosphate. Thermospray and Electrospray.

U-51: Qualitative and quantitative applications of IR and UV to pharmaceuticals.15hrs

Dexamethasone, Hydrocortisone, Dapsone and Diazepam. Quantitative applications of IR: Measurement of absorbance-baseline method, calibration graph method, standard addition method. Eg: Determination of amount of phenobarbitonr in phenobarbitone tablets, determination of the amount of acetyl salicylic acid and phenacetin in commercial samples. Qualitative applications of UV: Eg: Vitamin-A₁, A₂, Calciferol, Iso-vitB₂, Precalciferol, steroidal enones, Ephedrine, Ketoprofen, Procaine and phenylepherine. Quantitative applications of UV: Use of standard absorptivity value, use of calibration graph, single point and double point standardisation. Assay of substances in multicomponent samples, assay as a single component sample. Assay after solvent extraction, assay after collection for interference, simultaneous equation method. Eg. Flusemide in tablet form, mixture of pethidine hydrochloride and chlorocresol. Difference spectrophotometry- analysis of aspirin in dextropropoxyphene compound tablets

U-52: Principles and pharmaceutical applications of AAS , AES and Spectrofluorimetry

15hrs

Atomic absorption spectroscopy: Principle, instrumentation, radiation source, monochromator, detector, amplifier. Readout device, detection limit and sensitivity. Analytical techniques- calibration curves, standard addition method. Applications: Assay of total zinc in insulin zinc suspension, determination of thiomersal as mercury in a solution for contact lenses.

Atomic emission spectroscopy(Flame photometry): Principle, instrumentation-burner, mirrors, slits, monochromators, filters, detectors. Quantitative analysis- Direct calibration, standard addition method, internal standard method. Applications- Determination of calcium in magnesium chloride for dialysis, determination of the concentration of potassium in haemodialysis solution.

Spectrofluorimetry: Theory, instrumentation- excitation sources, wavelength selection and signal processing. Quantitative aspects, applications- determination of proflavinhemisulphate in proflavin cream, determination of ethinyloestradiol tablets

Recommended text books :

1. Practical pharmaceutical chemistry by Beckett & Stenlake
2. Fundamentals of analytical chemistry by Skoog & West
3. Organic spectroscopy by William Kemp
4. Organic spectroscopy by Kalsi Instrumental methods of analysis by B.K.Sharma
5. Pharmaceutical analysis by Watson

References.

1. Spectroscopic identification of Organic Compounds. By Silverstein, Basseler & Morri
1. Instrumental methods of analysis by Chatwal & Anand
2. British open university monograph
3. Organic spectroscopy by Jagmohan
4. Vogel's quantitative chemical analysis
5. Analytical profiles of drugs
6. Analytical chemistry by Christian

Paper-XIV:Advanced chromatographic techniques

(P.Chem 802)

U-53: Applications of solvent extraction

U-54: Gas chromatography and GC-MS

U-55: HPLC and HPLC-MS

**U-56: Size-exclusion chromatography, Capillary electrophoresis
And UPLC**

U-53: Applications of solvent extraction

15hrs

The distribution coefficient distribution ratio, relation between K_d and D , multiple extractions, efficiency, calculations. Role of liquid-liquid extraction in pharmaceutical analysis, Factors influencing solvent extraction – temperature, inert solutes, pH, ion-pair formation, synergism. Emulsion problems. Types of extraction procedures – batch extraction, continuous extraction, counter current extraction. Super critical fluid extraction. Determination of salts of organic acids and bases, determination of alkaloids in crude drugs, use of liquid-liquid extraction in assay of cyclizine lactate injection, Vitamine A tablets, PGE₁ .

U-54: Gas chromatography and GC-MS

15hrs

Instrumentation, Supply of carrier gas, sample injection system, column, detectors (TCD, FID and ECD), programmed temperature gas chromatography, chiral selectivity. Identity tests of pharmacopeal products . Methods of quantitation, specific applications, analysis of methyl testosterone in tablets, analysis of atropine in eye drops.

GC-MS: Principle, instrumentation, interfaces, jet separator, mass analyzer, mass chromatogram, ionization techniques (electron impact, positive ion chemical ionization, negative ion chemical ionization), application to impurity profiling . Residual solvents/ organic volatile impurities by Head space gas chromatography.

U-55: HPLC and HPLC-MS

15hrs

Instrumentation, mobile phase reservoirs, pumps, gradient formers, sample injection, columns, detectors, Technique: Derivatization in HPLC. Separation of enantiomers by chiral HPLC. Identity tests of pharmacopeal products. Methods of quantitation. Specific applications- assay of paracetamol and aspirin in tablets. Assay of hydrocortisone cream. HPLC-MS: Instrumentation, principle, direct liquid introduction, interfaces and applications : Impurity profiles.

U-56: Size-exclusion chromatography, Capillary electrophoresis And UPLC

15hrs

Principle, performance, apparatus and technique, applications: determination of relative component composition. Determination of molecular weight eg. corticotrophin and insulin.. High performance capillary electrophoresis (CE).Electrophoresis, electro osmotic flow, integration in CE, instrumentation, control of separation, applications: Separation of atenolol and related impurities, analysis of nonsteroidal anti inflammatory drugs. UPLC

Recommended text books:

2. Practical pharmaceutical chemistry. By A.H. Backette, J.B. Stenlake
3. Fundamentals of analytical chemistry. By Skoog and West.
4. Pharmaceutical analysis. By Takeru, Higuchi
5. Pharmaceutical analysis By. Watson
6. Pharmaceutical analysis By Chapman
7. Pharmaceutical analysis By Ashtoshkar .
8. Instrumental methods of chemical analysis By Sharma

References:

1. Chemical HPTLC & applications By Sethi
2. Gas chromatography By Willett
3. High pressure liquid chromatography By Veronica and Meyer & Beene
4. Analytical chemistry By Harris
5. High performance liquid chromatography By Lindsay

6. Vogel's quantitative analysis

Paper-XV: Medicinal Natural products

(P.Chem 803)

U-57: Antibiotics

U-58: Vitamins

U-59: Steroids, hormones & Glycosides

U-60: Alkaloids.

U-57: Antibiotics:

15hrs

Brief historical background, definition, requirements for a substance to be an antibiotic and classification in to- β -lactams- (Pencillins, Cephalosporins) Tetracyclines-(Tetracycline, aureomycin) Amino glycosides- (Streptomycin, Neomycin) Macrolides- (Erythromycin, Chloramphenicol) Polypeptides-(Bacitracin).

Pencillins- Structures of different pencillins, nomenclature and reactions-

(Hydrolysis of pencillin by cold and hot dil. Mineral acids, alkali, enzymatic hydrolysis with pencillinase, amidase and methanolysis folloed by aqueous mercuric chloride.

Classification in to Oral and parenteral based on spectrum of activity and ressistance to β -lactamase and into natural, biosynthetic, and semisynthetic. General methods of synthesis of pencillins from 6-APA.

Cephalosporins- Brief historical background and biological sources. Structures of important Cephalosporins and Cephameycins. Acid hydrolysis of Cephalosporin-C. Comparison of 6-APA, and 7-ACA, penam and Cepham. Classification in to Oral and parenteral, SAR and advantages over pencillins.

Tetracyclins- Biological sources, structures of important tetracyclines, Amphoteric nature, epimerisation, chelation with metals, mechanism of action, spectrum of activity, SAR and toxicity.

Aminoglycosides- Structure of Streptomycin, acid hydrolysis, mechanism of action, therapeutic uses and toxicity. Structure of Neomycin.

Macrolide antibiotics- A brief account of Erythromycin and Azithromycin

U-58: Vitamins

15hrs

Vitamins: Definition, occurrence, classification into fat soluble and water soluble. structural formulae and physiological functions of vitamins-

Fat soluble- A1(Retinol 3,7-dimethyl-9-(2,6,6-trimethyl-1-cyclohexen-1-yl)-2,4,,6,8-nonatetraene-1-ol), A2(3,4 didehydro rotenol), D₂ (Calciferol, -9,10-secoergosta-5,7,10(19),22-tetraene-3-ol) ,E (Tocopherol) and K(Phylloquinone)..

Water soluble- B1(Thiamine), B2(Riboflavin), B6(Pyridoxin), Nicotinic acid, B12 (cyanocobalamine (5,6-dimethyl benzimidazolyl cyanocobamide) and vitamin C(Ascorbic acid),

U-59: Steroids, hormones & Glycosides

15hrs

Steroids, hormones- Source, structure, synthesis, pharmacological activity and analysis of: cholesterol, cholic acid. Hormones: source, classification, structure, synthesis, pharmacological activity and analysis of: androsterone, progesterone and cortisone.

Glycosides-Source, structure, biogenesis , pharmacological activity and analysis of : digitoxin, digoxin & sennosides ,

U-60: Alkaloids

15hrs

Definition, General methods of extraction, color reactions and general methods of structure determination.

Structure determination, synthesis and pharmacological action of the following alkaloids. Benzyl isoquinoline alkaloids-Atropine, Opium alkaloids- Morphine
Quinoline alkaloids- Quinine.

Recommended text books:

1. Natural products. By P.S.Kalsi
2. Organic natural products By Barton and Ollis
3. Natural products By Bhat et al

References

1. Alkaloids. By Manske
2. Alkaloids By Pelletier
3. Alkaloids By Bentley
4. Organic natural products by OP Agarwal
5. Organic Chemistry By IL Finar vol1,2
6. Medicinal natural products by Dewick
7. Medicinal natural products by Dewick

Paper-XVI:Basics in Pharmacology

(P.Chem 804)

U-61: General Principles Of Pharmacology

U-62: Drugs Acting On CNS & ANS

U-63: Drugs Acting On Cardio Vascular & Respiratory System

U-64: Drugs Acting On Renal And Gastro Intestinal System

U –61: General Principles Of Pharmacology

15hrs

Introduction, Nature and sources of drugs, Routes of administration of drugs. Concept of absorption, bioavailability, Drug distribution, Biotransformation and excretion drugs, Biological half-life and its significance. Types of receptors. Mechanism of action including drug receptor Interactions and factors influencing them. Dose response relationship.

U-62: Pharmacology Of Drugs Acting On Cns & Ans

15hrs

Introduction, Transmission, Distribution and Functions of Drugs acting on Central Nervous System: CNS Neuro transmitters; CNS Stimulants: Hypnotics and Anxiolytics; Anti-psychotic Agents; Anti-epileptic Agents; Anti-depressants and Mood Stabilizers. Pharmacological management of Parkinsonism and other movement disorders; Introduction, Transmission,

Distribution and Functions of Drugs acting on Autonomic Nervous System: Cholinoceptor – Activating and cholinesterase inhibitory drugs, Cholinoceptor blocking drugs, Adrenoceptor – Activating and other sympathomimetic drugs, Adrenoceptor – Antagonist drugs.

U-63: Drugs Acting On Cardio Vascular & Respiratory System **15hrs**

General considerations, Pharmacology of drugs used in the treatment of congestive heart failure, Anti-arrythmics, Anti-hypertensives & Anti-hyperlipedemic drugs, Anti-anginals and Vasodilators. Drugs used in the therapy of shock.

Pharmacology of Drugs affecting Respiratory System: Drugs used in the treatment of disorders of Respiratory Function and Bronchial Asthma. Bronchodialators, Antitussives and expectorants.

U-64: Drugs Acting On Renal And Gastro Intestinal System **15hrs**

Diuretics and anti-diuretics, Water and Electrolytic Balances and pH modifying agents.

Pharmacology of purgatives/laxatives, Anti-diarrhoeals, Emetics and Anti-emetics.

Drugs used in peptic ulcers.

TEXT BOOKS:

1. **Pharmacology and Pharmacotherapeutics**, R.S. Satoskar and S.D. Bhandarker, Popular Prakashan, Mumbai.
2. **Pharmacology**, H.P. Rang, M.M. Dale & J. M. Ritter : Churchill Livingstone, 4th edition.
3. **Basic and Clinical Pharmacology**, 9th edition – Bertram. G. Katzung.

REFERENCE BOOKS:

1. **Essentials of Medical Pharmacology**, K.D. Tripathi, J. P. Brothers Medical Publishers.
2. **Lewis's Pharmacology**, by J. Crossland, Churchill Livingstone.
3. **Pharmacological Principles of Medical Practice**, by Krantz and Care, Williams and Wilkins co.
4. Goodman and Gilman's, **The Pharmacological Basis of Therapeutics**. J. G. Hardman and Lee E. Limbard, Mc. Graw Hill, Health professions Division.

Laboratory

Paper-XIII: Spectral Evaluation of the structure of Organic pharmaceuticals and intermediates. **(P.Chem 851)**

Identification of unknown pharmaceuticals and intermediates by interpretation of IR,UV, Proton 2-Dand C¹³ NMR and Mass spectra

Paper-XIV: Chromatographic applications to pharmaceuticals (P.Chem 852)

Column chromatography- Separation and identification of chlorophylls, xanthophylls and carotenes in leaves.

Ion-Exchange chromatography: Separation and estimation of metal ions ininorganic pharmaceuticals.

High performance liquid chromatography- Determination of aspirin, paracetamol and caffeine in APC tablets. 2. Determination of benzocaine and phenazone in eardrops.

Paper-XV: Isolation of Natural products and their color reactions (P.Chem 853)

Isolation of Herbal Drugs:

1. Piperine from black Pepper
2. Caffeine from tea leaves
3. Menthol from mint leaves
4. Cineole from Eucalyptus leaves
5. Casein from milk

6.Strychnine from Strychnus nuxvomica seeds

Preparation of reagents for color reactions and testing : Testing of alkaloids in pure form and from plant extracts by Dragendorff's, Mayer's, Wagner's. Reagents. Tests for steroids and steroidal glycosides by Liebermann Buchard test, Salkovisky reaction. Test for flavonoids by Shinoda test (Mg/HCl), FeCl₃ test

Paper-XVI: Seminars & viva (P.Chem 854)

Mahatma Gandhi University, Nalgonda
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Semester-IX

S.No	Subject	Paper (Theory)	Teaching hrs/week	Examination hrs	Internal marks	Final Exam marks	Total marks	Credits
1.	Pharmaceutical Chemistry (P.Chem 901)	P-XVII	4	3	20	80	100	4
2.	Pharmaceutical Chemistry (P.Chem 902)	P-XVIII	4	3	20	80	100	4
3.	Pharmaceutical Chemistry (P.Chem 903)	P-XIX	4	3	20	80	100	4
4.	Pharmaceutical Chemistry (P.Chem 904)	P-XX	4	3	20	80	100	4
		Practical classes						
1.	Pharmaceutical Chemistry (P.Chem 951)	P-XVII	6	6	-	60	60	4
2.	Pharmaceutical Chemistry (P.Chem 952)	P-XVIII	6	6	--	60	60	4
3.	Pharmaceutical Chemistry (P.Chem 953)	P-XIX	6	6	--	60	60	4
4.	Pharmaceutical Chemistry (P.Chem 954) Seminars & viva voce	P-XX	2	-	-	20	20	1
Total							600	29

Semester-IX

Paper-XVII: Pharmaceutical design and development (P.Chem 901)

Paper-XVIII: Process Chemistry (P.Chem 902)

Paper-XIX: Biochemical analysis & Clinical trials (P.Chem 903)

Paper-XX: Intellectual Property Rights (P.Chem 904)

Paper-XVII: Pharmaceutical design and development (P.Chem 901)

U-65: Principles Of Drug Discovery & SAR studies

U-66: QSAR Studies

U-67: Molecular Modeling

U-68:Modelling Biomolecules

U-65: Principles Of Drug Discovery & SAR studies: 15hrs

Drug discovery without lead –Serendipity- Pencillins and Librium. Lead discovery- random screening nonrandom screening.(screening of natural products, medical folklore, screening synthetic banks metabolic studies and clinical trials).

SAR studies : Introduction i.Binding role of hydroxy group, Amino group, aromatic ring, double bond, ketones and amides. ii. Variation of substituents- alkyl substituents, aromatic substituents, extension of structure, chain extension/contraction, ring expansion/contraction, ring variation, ring fusion.Isosteres.iii. Simplification of the structure, rigidification, conformational blockers, X-ray crystallographic studies. Drug development based on structure pruning-Morphine modification .Development of Cimetidine and Captopril from the lead molecules.

U-66: QSAR Studies: 15hrs

Introduction. A) QSAR parameters – Substituent constants- i.Linear relationship between log p and biological activity ii.Non-linear relationship between log p and biological activity.Electronic parameters, Steric parameters, effect of electronic and steric parameters on lipophilicity.B. Methods used in QSAR studies-i.Linear free energy relationship (LFER). Application of Hammett equation, Hansch analysis, significance of slopes and intercepts in Hansch analysis. ii.Craig's plot. iii.Topliss scheme iv.Free Wilson model – advantages and disadvantages v.Cluster significant analysis vi.Minimal topological difference method.QSAR case study – on Pyranamine. Achievements of QSAR – Forecasting biological activity, selection of proper substituents, bioisosterism, drug receptor interactions and pharmacokinetic information.

U-67: Molecular Modeling: 15hrs

Introduction to Quantum, classical and statistical mechanical approaches to molecular modeling. Property evaluation through approximate molecular orbital procedure. Brief introduction to

Schrodinger wave equation, Born –Oppenheimer approximation, Hartree approximation. Huckel molecular orbital theory and the approximations in HMO. Illustration (using butadiene, allyl cation, anion and radical) of calculating wave functions and electron density through Huckel molecular orbital theory. Local and global minima. Potential energy surfaces, Co-ordinate system (Cartesian and Polar) Geometry optimization procedures. Differences between Quantum mechanical and classical mechanical approaches. Empirical force field (Molecular mechanics) methods. Potential for bond stretching, bending, torsional, columbic and non bonded interactions. Qualitative (brief) exposure to molecular dynamics simulations, conformational analysis.

U-68 : Modeling Biomolecules:

15hrs

Challenges and limitations of quantum chemical and molecular mechanics methods in modeling biomolecules: Nucleic acids, proteins, carbohydrates and lipids. Protein folding. Protein structure prediction, Ramachandran plot. Secondary structure. Comparative protein modeling. Homology modeling, ab initio structure prediction and threading.

Introduction to proteomics and genomics.

Computer aided drug design. Structure and analog based approaches. Quantitative structure activity relationships. Pharmacophore based approaches. Molecular docking. De novo ligand design.

Recommended books:

5. Burger's medicinal chemistry and drug discovery. By Manfred E. Wolf.
6. Introduction to Medicinal chemistry. By Patrick.
7. Introduction to drug design. By Silverman
8. Principles of medicinal chemistry. By William Foye
9. Biochemical approach to medicinal chemistry. By Thomas Nogrady.
10. Pharmaceutical Chemistry and Drug synthesis By Roth and Kleeman

References:

9. Drug design By E.J. Arienes
10. Jenkin's quantitative pharmaceutical chemistry By Knevel and Dryden
11. Recent advances in Bioinformatics By IA. Khan and A Khanum
12. Computational chemistry By GH. Grant and WG. Richards
13. Molecular modeling By Hans Dieter Holtje and Gerd Folkers
14. Molecular modeling By Leach
15. Computational Chemistry by Jensen
16. Comprehensive medicinal chemistry. Vol 1-5 By Hansch.

Paper-XVIII: Process Chemistry (P.Chem 902)

U-69: Microwave assisted synthesis

U-70: Unit process-I

U-71: Unit process-II

U-72: Quality control & quality assurance

U-69: Microwave assisted green synthesis:

15hrs

Microwave assisted reactions in water- Hoffman elimination, hydrolysis, oxidation of toluene, oxidation of alcohols, hydrolysis of methyl benzoate.

Microwave assisted reactions in organic solvents- esterification, Fries rearrangement, Claisen rearrangement, Diels – Alder reaction

Microwave solvent free reactions (Solid state)- Synthesis of nitriles from aldehydes, synthesis of anhydrides from dicarboxylic acids. Synthesis of heterocyclics- Aziridines, β -lactams, pyrrole, Furan, prazole, pyridines, coumarins, quinolines and thiadiazepines

U-70 Unit process-I

15hrs

Definition and scope of the following processes

Halogenation- Thermodynamic and kinetics of halogenation reactions, technical halogenations.

Hydrolysis- Hydrolyzing agents, materials susceptible to hydrolysis, kinetics, thermodynamics and mechanism of hydrolysis, technical operations involving hydrolysis.

Hydrogenation- Catalytic hydrogenation, kinetics, thermodynamics of hydrogenations, general principles concerning hydrogenation catalysts.

U-71: Unit Process-II

15hrs

Definition and scope of the following processes.

Alkylation- Types of alkylation, alkylating agents.

Esterification- Esterification of organic acids, inorganic acids and of carboxylic acid derivatives.

Sulphonation and sulfation and Nitration- Sulphonating and sulfating and nitrating agents.

Their principal applications, kinetics, mechanism and thermodynamics. Technical preparation of sulphonates, sulfates and nitrates.

U-72: Quality control & quality assurance

15hrs

Introduction, concepts and significance, Quality control charts, the X-quality control chart, the R-quality control chart and its interpretation, spiked sample control charts, blind samples in control .

Establishing Quality assurance programme-management commitment, writing standard operating procedures, topics for standard operating procedures, consolidating the programme, monitoring quality assurance data, reporting quality assurance problems, writing the quality assurance manuals.

Good laboratory practices: Organisation and personnel, quality programme, instrument and calibration, customer satisfaction.

Laboratory Accreditation: need for laboratory accreditation, international aspects of laboratory accreditation and in India. Criteria for laboratory accreditation. Benefits of laboratory accreditation. Significance of ISO 9000-2000, 9001-2000, 9003-2000, 9004-2000 series of standards. Good laboratory practice.

Recommended books:

1. New trends in green chemistry by V.K. Ahluwalia and M. Kidwai
(Anamaya publishers)
2. Green Chemistry- An introductory text By Mike Lancaster
(RSC Publications, UK 2002)
3. Green Chemistry- Environment friendly Alternatives by

Rashmi singh and M.M .Srivastava (Narosa publishing house)

4. Unit Processes in organic synthesis by P.H.Groggins

5. Macgrahill and Kugetinsh ltd

6. Outlines of Chemical Technology by Dryden

7. Chemical process industries by Shrieve N

Paper-XIX: Synthetic pharmaceuticals & Clinical trials & Biochemical analysis

(P.Chem 903)

U-73: Synthetic Pharmaceuticals-I

U-74: Synthetic Pharmaceuticals-II

U-75: Clinical trials

U-76: Biochemical analysis

U-73: Synthetic Pharmaceuticals-I

15hrs

Synthesis and pharmacological activity of the following drugs. Benzocaine (local anaesthetic), Phenobarbitone, Nitrazepam (hypnotic), Diclofenac, celecoxib, (anti-inflammatory), Pheniramine (anti-histamine), Enalapril (anti-hypertensive), Isoprenaline (sympathomimetic), procainamide (cardio-vascular) and omeprazole (anti-ulcer).

U-74: Synthetic Pharmaceuticals-II

15hrs

Synthesis and pharmacological activity of the following drugs:- Cis-Platin, 5-Fluorouracil (anti-cancer), Tinidazole (anti-amoebic), Miconazole (anti-fungal), Ciprofloxacin, norfloxacin (antibacterials), Ethambutol (Anti-tubercular), Clofazimine (anti-leprosy and anti-T.B.), Cloxacillin, Cephalexin (anti-biotics) and Lamivudine (anti-AIDs).

U-75: Clinical trials & Bioassays.

15hrs

Preclinical studies-Acute, subacute and chronic toxicity.

Clinical observations: phase I, phase-II, phase-III, phase -IV trials. (Introductory treatment). Principles of Bioethics, Bioethics of Animals used in Bioassay studies; Principles of Bioassay; Official Bioassay; Biological assay of anti-haemophilic fraction, Heparin sodium, Chorionic gonadotropin, Corticotropin, Insulin, Oxytocin, Vasopressin and Adrenaline

U-76: Biochemical analysis:

15hrs

Assay of drugs by biochemical method: ELISA (Cortisol, Cocaine, Opiates, alcohol, Vaccines, Hormones. Kidney and lung function tests –Tuberculosis, enzymes

Radio immuno assay: Introduction, theory, Hapten determinants and purity. Importance of Antigenic determinants analysis by competitive antibody binding of isotopically labelled compounds. Instrumentation. Methods of assay. Applications to pharmaceuticals- RIA of

Morphine, Chlozepam, Flurazepam in human plasma and Barbiturates.. Biological assay of diphtheria anti-toxin, anti-rabies vaccine, tetanus anti-toxin and old tuberculin vaccine

Recommended books

- 1.Chemistry of Drugs. By V.N.Ivers.
- 2.May's chemistry of synthetic drugs. By G.M.Dyar
- 3.The organic chemistry of Drug synthesis.vol 1-6 By Ledneicer etal.
- 4.Top Drugs: The synthetic routes. J.Saunders.
- 5.Medicinal chemistry. By Chatwal.
- 6.Medicinal chemistry. By Ashtoshkar.

References

- 1.Biochemistry. By Lehninger.
- 2.Biochemistry. By Stryer.
- 3.Introduction to Medicinal chemistry. By Patrick.
- 4.Comprehensive medicinal chemistry. Vol 1-5 By Hanzsch.
- 5.Principles of medicinal chemistry. By William Foye
- 6.Biochemical approach to medicinal chemistry. By Thomas Nogrady.
- 7.Textbook of organic medicinal and pharmaceutical chemistry. By Delgrado and William

Paper-XX: Intellectual Property Rights & Regulatory Affairs (P.Chem 904)

U-77: Patents and Intellectual property Rights

U-78: GATT and WTO

U-79: Regulatory affairs and related quality systems

U-80: Documentation

U-77: Patents and Intellectual property Rights

15hrs

Introduction, Intellectual Property Rights (IPR),Definition, scope,objectives,sources of patents information, patent processing and application. Patents, Trademarks, Copyrights, Trade secrets, salient features of trade related aspects (TRIPS), their protection.International and regional agreements.

U-78: GATT and WTO

15hrs

Historical perspective, objectives, fundamental principles, impact on developing countries. WTO- objectives, scope, functions, structure, status, membership & withdrawal, dispute settlement. Impact on globalization, India- tasks and challenges.

U-79: Regulatory affairs and related quality systems

15hrs

Regulatory affairs: Indian context- Requirements and guidelines of GMP, understanding of drugs and Cosmetic Act 1940 and rules 1945 with reference to Schedule M,U and Y.

Related quality systems- Objectives and guidelines of USFDA, WHO and ICH. Introduction to ISO series.

U-80: Documentation**15hrs**

Types related to pharmaceutical industry, protocols. Harmonizing formulation development of global fillings, NDA, ANDA, CTD, dealing with post approval changes- SUPAC, handling and maintenance including electronic documentation.

References;

1. Intellectual property rights by N.K.Acharya
2. Law relating to patents, trademarks, Copyright designs and geographical indications by B.L.Wadehra
3. Good manufacturing practice of Pharmaceuticals by SHWillig, vol 78, Marcel, Dekker NY
4. Protection of industrial property rights by P.Das and Gokul Das
5. Law and Drugs, law publications. SNKatju
6. Original laws pub by Govt of India
7. Law of Drugs in India by Hussain
8. New drug approval process, RAGuaino, vol 100, Marcel Dekker, NY

Laboratory:**Paper-XVII: Synthesis of Organic pharmaceuticals by green method (P.Chem 951)**

1. **Microwave method-** Synthesis of Aspirin, Synthesis of Quinoxaline-2,3-dione, Decarboxylation of Indole-2-Carboxylic acid, Synthesis of Phthaloylglycine
2. **Sono Chemistry-** Coupling reaction of Bromobenzene to yield Biphenyl, Sonification of diphenyl aniline with benzyl bromide to give N- N-benzylated product.

Paper-XVIII: Advanced Chromatography (P.Chem 952)

- GLC Or GC experiments: 1. Determination of specific organic compounds as impurities in official pharmaceutical substances. Example Determination of N,N-Dimethyl aniline in Cephalexin.
- Determination of related substances in official drugs.- Eg. Bromopheneramine maleate
- Assay of human insulin by HPLC
- Assay of Theophylline by HPLC

Paper-XIX: Research Methodology (Project planning) (P.Chem 953)

Model project writing and presentation by ppt.

Paper-XX: Seminars & viva**(P.Chem 954)****Semester-X: Project work (full semester)****Evaluation by grading**

