M.Sc. Pharmaceutical Chemistry
University of Lucknow

Programme Outcomes

PO-1. Demonstrate, solve and an understanding of major concepts in all disciplines of Chemistry independently and in group as well as draw logical conclusions through Project and Seminar Presentation.

PO-2. Encourage students to make critical thinking and the scientific knowledge gained would help them to design, carry out, record and analyze the results of Chemistry as well pharmaceutical experiments.

PO-3. Equip students to face the employment challenges and instil confidence to turn into entrepreneur and also step into research career.

PO-4. Generation of new scientific insights or to the innovation of new applications of chemical research

PO-5. Present scientific and technical information resulting from laboratory as well as Industrial/pharmaceutical experimentation in both written and oral formats, would make them perfect.

PO-6. Learns modern methods of chemical systems in a laboratory setting make them perfect for any scientific laboratory and industry.

PO-7: The students will become well versed in the mechanisms and also with the mode of action of drugs.

PO-8. The present course content will build confidence in students and the students will improve their competencies on par with their counterparts in premier institutions across the nation.

Programme Specific Outcome

PSO-1 Students will be able to understand the basic concepts of bio-inorganic, bio-organic, physical chemistry, analytical chemistry, drug formulation, drug design and development, and green chemistry

PSO-2. Students will develop the ability to present pharmaceutical chemistry research by means of an oral presentation, a scientific poster or a written report.

PSO-3. Students will be able to use and apply professional softwareôs relevant to chemistry.

PSO-4. Students will be able to demonstrate knowledge to develop Pharmaceutically important molecules, new drug delivery systems etc.

PSO-5. Students will demonstrate an ability to analyze and interpret data of analytical experiments in production, quality control & assurance of pharmaceutical synthesis and formulation.

PSO-6. Students will be able to apply analytical tools for determination of organic molecules.

PSO-7. Students will be able to generate validation protocol for all pharmaceutical operations starting from drug research to development to formulation.

PSO-8. Learn Role of drugs to inhibit the particular enzymes and treatment of disease

PSO-9. Learn Mode of action of different drugs.

M.Sc. PHARMACEUTICAL CHEMISTRY

PROGRAMME STRUCTURE

The Master of Science in Pharmaceutical Chemistry is a Two Year Full Time Course consisting of Four Semesters.

Semester I
Semester II
Semester III
Semester IV

COURSE SRUCTURE

Semeste	Core Course			Elective Course			Open elective Course			Value Added		Total Credits
	No. of Papers	Credits (L+T/P	Total Credits	No. of Papers	Credits (L+T/P	Total Credi	No. of Paper	Credits (L+T/P	Total Credits	No. of Papers	Credi	
I	4	16+8	24	0	0+0	0	0	0+0	0	1	4	28
II	4	16+8	24	0	0+0	0	0	0+0	0	0	0	24
III	2	8+8	16	1	4+0	4	1	4+0	4	0	0	24
IV	1D	12+4	16	1	4+0	4	0	0+0	0	0	0	20
Total C			80			8			4		4	96

Semester-IV

Paper Code	Title of the paper	Credits	Int. Ass.	Uni. Exam.	Marks
CCTP-11	PC-401A: Dissertation on Four Months Internship in Pharmaceutical Companies or Science Institutes	8	-	-	200
	PC-401B: Evaluation and Viva on the submitted dissertation (Internal)	4	-	-	100
CCEP-2. Course Elective (Intra Department)	PC-402A: Biochemistry and Bacteriology/MOOC Or PC-402B: Analytical Chemistry/MOOC	4	30	70	100
CCPP-6	PC-403: Advanced Organic Chemistry Practical	4	Cont. Eval.		100
	Total	20			500

CCTP (Core Course Theory Paper). CCPP (Core Course Practical Paper). CCEP (Core Course Elective Paper). COEP (Course Open Elective Paper).

M.Sc. Pharmaceutical Chemistry Semester IV Syllabus
Paper Code CCTP-10: Pharmaceutical Internship (PC-401A, PC-401B)
Credits 12 (8+4) MM 300 (200+100)

Course Outcome:

CO-1. To learn the procedure of identifying, approaching, applying and getting approval of internship from pharmaceutical companies.
CO-2. To witness the entire work area of the pharmaceuticals.
CO-3. To understand the nature of job.
CO-4. To identify the RD procedures and technical skills involved.
CO-5. To understand the complete mechanism of the reactions involved in the manufacturing areas at different sectors.
CO-6. To correlate the manufacturing procedures with simple laboratory synthesis.
CO-7. To learn the environment aspects, pollution, their control involved in the manufacturing unit.
CO-8. To prepare a final evaluation report and presentation for the internship carried out for 90 to 100 days.

3-4 Months training in any Pharmaceutical or Scientific laboratory. After the completion of training project report will be submitted, followed by its evaluation by presentation & viva-voce examination.

M.Sc. Pharmaceutical Chemistry Semester IV Syllabus
Paper Code CCEP-2: Biochemistry and Bacteriology (PC-402A)
Credits 4 MM 100 (70+30) Hours 60

Course Outcome:
After the completion of the course the student will acquire the knowledge of-

CO-1. cell cycle, cell division and cell death mechanisms, the discovery of DNA as genetic material.
CO-2. exposure with the nature of various biomolecules present in living cells and also the amino acid and nucleotide sequences of proteins and DNA respectively.
CO-3. basic concepts of bioenergetics, mechanisms of oxidative phosphorylation and photophosphorylation., carbohydrate metabolism, blood sugar, diabetes.
CO-4. importance of lipids as storage molecules and as structural component of biomembranes.
CO-5. composition of blood cells, urine and acid base balance, the concepts of genomics, proteomics, metabolomics and their importance in human health.

Unit I

Amino acids, Proteins and Nucleic Acids: Cells-classification and cell division. Ramachandran plot and secondary structure of proteins. Tertiary structure and structural motifs-protein folding and domain structure of proteins. Quaternary structure of proteins. Purification and characterization of proteins. Functions of proteins. Chemical synthesis of proteins-protecting groups, solid phase peptide synthesis. DNA and RNA. Double helical structure of DNA. Replication of DNA. RNAclassification of RNA. Genetic code. Nucleic acids as carriers of genetic information. Protein biosynthesis.

Unit II

Enzymes and Hormones: Nomenclature and classification of enzymes. Mechanism of enzyme action.Substrate specificity of enzymes. Enzyme inhibition. Isoenzymes. Allosteric enzymes. Enzyme synthesis. Enzymes and digestion of food. Clinical uses of enzymes. Immobilization of enzymes. Clinical tests for sugar and cholesterol. ELIZA.
Functions and modes of actions of hormones. Pituitary, thyroid, parathyroid, pancreatic, adrenal and adrenocortical hormones. Male and female sex hormones.Antihormones.

Unit III

Biological Oxidation and Metabolism:ATP and ADP. Oxidative phosphorylation. Cytochromes. Food as a source of energy. Calorific value of food. Basal metabolism.Respiratory quotient. Carbohydrate metabolism: Glycogenesis and Glycolysis. Blood sugar level. Cori cycle. The role of insulin. The citric acid cycle. Genetic and metabolic disorders. Diabetes mellitus (type 1 and type 2).

Unit IV

Lipid metabolism. Lipaemia. Oxidation of fatty acids. Ketogenesis and ketosis. Biosynthesis of fatty acids. Essential fatty acids.
Prostaglandins-nomenclature, structure and biosynthesis.
Metabolism of amino acids and proteins. Oxidative deamination and trans amination reactions. Urea formation-ornithine cycle. Inborn errors of metabolism.

Unit V

Blood Composition and Acid Base Balance: Blood groups-Rh factor. Blood transfusion. Composition of blood cells.Chemistry of haemoglobin. Anaemias. Plasma proteins. Blood clotting- factors and mechanism. Coagulants.
Regulation of acid base balance. Acidosis and alkalosis. Renal functionformation and composition of urine.
DNA fingerprinting technique. Elementary principles of Recombinant DNA technology, gene therapy, cloning and bioinformatics.

Recommended Books:

1. D.L. Nelsen, M.M. Cox, Lehninger Principles of Biochemistry, 5 th Edn., W.H. Freeman, 2008.
2. J.M. Berg, J.L. Tymoczko, L. Stryer, Biochemistry, 5th Edn., W.H. Freeman, 2002.
3. A.J. Salle, Fundamental Principles of Bacteriology, Tata McGraw Hill, 1984.
4. Schaums Outline of Human Anatomy and Physiology, Third Edition (Schaums Outline Series)
5. Plants Physiology ï Lincoln Taiz and Eduardo Zeiger
6. Cell Biology ï 2010 ï Dr. C.B.Powar
7. Lehninger Principles of Biochemistry ï David L. Nelson and Michael M. Cox

M.Sc. Pharmaceutical Chemistry Semester IV Syllabus
Paper Code CCEP-2: Analytical Chemistry (PC-402B)

Credits 4 **MM 100 (70+30)** **Hours 60**

Course Outcome:

After the completion of the course the student will acquire the knowledge of-

CO-1. gain general basixs, principles and application of chemistry, assess and interpret the different properties of chemical method of analysis.
CO-2. types of titration, titration curve, the concentration of an acid or base that has been titrated to equivalence and different types of indicators.
CO-3. fundamental thermodynamics behind various separation methods like solvent extraction and select the operating conditions for various separation techniques.
CO-4. different types of chromatographic techniques and their operating principles also the instrumentation required for various separation techniques.

Unit I

Titrimetric and Gravimetric Methods of Analysis: General principles: Solvents in analytical chemistry, acid base equilibria, concentration systems, stoichiometic calculation, Quantitative analysis via functional group, spot tests. Bio-Assay: Quantitative assay of drugs by biological methods.Optical rotation, refractive index, atomic absorption, kinematic,Viscosity, pharmacokinetics.

Unit II

Acid-base titration, titration curves, acid base indicators, applications of acid-base titration, complexometric titration, metal-ion indicators, precipitation titration, Mohrôs titration, Volhardôs titration, adsorption indicators, Fajanôs titration, titration curves in oxidation-reduction titration, redox indicators, applications of redox titrations.

Unit III

Separation Techniques ï I: (A) Solvent Extraction: Fundamental treatment, theoretical principle, classification, and factors favouring extraction,extraction equillibria, applications. Liquid ï liquid extraction, use of oxime. Ultra centrifugation, dithiazone - in extraction.
(B) Solid phase extraction and solid phase micro extraction, applications.
(C) Ion- Exchange: Theories, use of synthetic ion exchange in separation, chelating ion exchange resins, liquid ion exchangers, experimental technique.

Unit IV

Separation Techniques ï II:An introduction to chromatographic methods, paper, thin layer and column chromatography, theory of chromatography, classification of chromatographic techniques, retention time, relationship between retention time and partition coefficient, the rate of solute migration,
differential migration rates, band broadening & column efficiency, kinetic variables affecting band broadening (No mathematical derivation), Electrophoresis and capillary electrophoresis.

Unit V

GC, LC and HPLC:Instrumentation of GC, LC and HPLC, applications in qualitative and quantitative analysis, comparison of GC and HPLC,Ion chromatography, pyrolytic gas chromatography, size exclusion chromatography, super critical fluid chromatography, affinity chromatography. Column matrices. Detectors. Affinity and chiral columns.

Recommended Books:

1. Introduction to instrumental analysis by R. D. Braun, MC. Graw Hill- International edition.
2. Analytical spectroscopy by Kamalesh Bansal- First edition.
3. Instrumental methods of chemical analysis by Willard, Dean and Merittee- Sixth edition.
4. Analytical chemistry principles by John H. Kenedey- Second edition, Saunders college publishing.
5. Spectroscopic identification of organic compounds Fifth Ed., Silvestrine, Bassler, Morrill, John Wiley and sons.
6. Analytical Chemistry, Ed. by Kellner, Mermet, otto, Valcarcel, Widmer, Second Ed. Wiley ï VCH 7) Vogelôs Textbook of quantitative Chemical Analysis, sixth Ed., Mendham, Denney, Barnes, Thomas, Pub: Pearson Education.
7. Instrumental methods of analysis. Willard Merrit, Dean and Settle, , 6th Edition, CBS Publisher, 1986.

M.Sc. Pharmaceutical Chemistry Semester IV Syllabus

Paper Code CCPP-6: Advanced Organic Chemistry Practical (PC-403)

Credits: 4 **MM: 100**

Course Outcome:

After the completion of the course the student will be able to:

CO-1. perform three step preparation of drugs and drug intermediates.
CO-2. Purify the synthesized compounds by crystallization.
CO-3. Perform chromatographic technique to check completion of reaction.
CO-4. different types of chromatographic techniques and their operating principles also the instrumentation required for various separation techniques.
CO-5. to characterize organic molecules by physical and spectroscopic means including UV, IR, ^{1}H & ^{13}C-NMR and Mass Spectroscopy.

Three steps synthesis of drugs and drug intermediates incorporating various name reactions.

Identification of organic compounds by using their spectral data (UV, IR, ^{1}H & ^{13}C-NMR and Mass Spectroscopy)

Recommended Books:

1. Vogel, A.I. A Textbook of Qualititative organic Analysis.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Sethi, Arun.,Systematic Lab Experiments in Organic Chemistry, New Age International Publisher.
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).
5. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).