M.PHARMACY

PHARMACEUTICAL ANALYSIS AND QUALITY CONTROL

I SEMESTER

Paper 101 - Modern Analytical Techniques
Paper 102 - Research Methodologies
Paper 103 - Advanced Pharmaceutical Analysis - I
Paper 104 - Chromatographic and Other Special Techniques
Paper 105 - Advanced Pharmaceutical Analysis-I - LAB
Paper 106 - Chromatographic and Other Special Techniques - LAB
Paper 107 - Seminar

II SEMESTER

Paper 201 - Advanced Pharmaceutical Analysis - II
Paper 202 - Quality Control of Pharmaceuticals
Paper 203 - Quality Assurance of Pharmaceuticals – I
Paper 204 - Drug Regulatory Affairs
Paper 205 - Advanced Pharmaceutical Analysis - II - LAB
Paper 206 - Quality Control of Pharmaceuticals - LAB
Paper 207 - Seminar

III SEMESTER

Paper 301 - Project Seminar-I (On the proposed project work with aims and objectives) - 50 Marks
Paper 302 - Project work - I

IV SEMESTER

Paper 401 - Project Seminar-II (On the experimentation and results of the project work) – 50 Marks
Paper 402 - Project work - II

SCHEME OF INSTRUCTIONS AND EVALUATION

PHARMACEUTICAL ANALYSIS AND QUALITY CONTROL

FIRST SEMESTER

Paper No.	Title of the Paper	Evaluation / Marks				Total	Credits
		Theory		Practical			
		Mid Examination	University End Examination	Mid Examination	University End Examination		
Paper – 101	Modern Analytical Techniques	40	60			100	3
Paper – 102	Research Methodologies	40	60			100	3
Paper – 101	Advanced Pharmaceutical Analysis-I	40	60			100	3
Paper – 102	Chromatographic and Other Special Techniques	40	60			100	3
Paper – 104	Advanced Pharmaceutical Analysis-I Practical			40	60	100	2
Paper – 105	Chromatographic and Other Special Techniques Practical			40	60	100	2
Paper – 106	Seminar					100	2
	TOTAL					700	18

SECOND SEMESTER

Paper No.	Title of the Paper	Evaluation / Marks				Total	Credits
		Theory		Practical			
		Mid Examination	University End Examination	Mid Examination	University End Examination		
Paper – 201	Advanced Pharmaceutical Analysis-II	40	60			100	3
Paper –202	Quality Control of Pharmaceuticals	40	60			100	3
Paper – 203	Quality Assurance of Pharmaceuticals-I	40	60			100	3
Paper – 204	Drug Regulatory affairs	40	60			100	3
Paper – 205	Advanced Pharmaceutical Analysis-II Practical			40	60	100	2
Paper – 206	Quality Control of Pharmaceuticals			40	60	100	2
Paper – 207	Seminar					100	2
	TOTAL					700	18

THIRD AND FOURTH SEMESTERS

Paper No.	III Semester	Total	Credits ***
Paper - 301	Project Seminar – I (On the proposed project work with aims and objectives)	50	2
Paper - 302	Project work - I	----	20
	Total	50	22

Paper No.	IV Semester	Total	Credits ***
Paper - 401	Project Seminar – II (On the Completed project work)	50	2
Paper - 402	Project work - II	---	20
	TOTAL MARKS	50	22
	GRAND TOTAL FOR THE COURSE	1500	80

M.PHARM SYLLABUS FOR PHARMACEUTICAL ANALYSIS AND

QUALITY CONTROL

I SEMESTER
PAPER 101: MODERN ANALYTICAL TECHNIQUES
(Paper Common for all Specializations)

Principles, instrumentation and applications of the following Instruments and Chromatography techniques

Unit- I

i. UV- Visible Spectrophotometry
ii. Infrared Spectroscopy
iii. Spectrofluorimetry

Unit- II

i. NMR Spectroscopy
ii. Electron Spin Resonance Spectroscopy
iii. Atomic Emission Spectroscopy

Unit- III

i. HPLC
ii. HPTLC
iii. Exclusion Chromatography
iv. Super Critical Fluid Chromatography

Unit- IV

i. Mass Spectroscopy including LCMS & GCMS
ii. GLC

Unit- V

i. Plasma Emission Spectroscopy
ii. X-Ray Diffractometry
iii. Optical Rotatory Diffusion
iv. Vapor phase Chromatography
v. Affinity Chromatography
vi. Ion-exchange Chromatography

TEXT BOOKS

1. Practical Pharmaceutical Chemistry Vol. 1 &II by Beckett & Stenlake.
2. Instrumental Methods of Analysis by Scog and West.
3. Instrumental Methods of Analysis by B.K.Sharma
4. Vogel's text book of Quantitative Chemical Analysis.
5. Instrumental methods of Analysis by Willard & Merrit.
6. A text book of Pharmaceutical Analysis by K. A. Conners.

REFERENCE BOOKS

1. I.P.
2. B.P.
3. U.S.P.
4. Remington's Pharmaceutical Sciences.
5. Spectroscopy B Silversterin

PAPER 102 -RESEARCH METHODOLOGIES
(Paper common for all Specializations)

UNIT I

Statistical Methods:

Chance Variation – Probability Distribution - Normal Distribution – Sampling Distribution

Error and its significance-Measures of Error- Control of Error in Experimental Investigations – Problem Solving.

UNIT II

Correlation and Regression, Multiple Regression - Problem Solving

UNIT III

Tests of Significance: Principles, t-test, z-test, F-ratio test, Chi-square test, Non-parametric tests- their applications in pharmacy research with examples – Problem Solving

UNIT IV

Design of Experiments

Criteria of a good design with examples.

Principles- Randomization, replication and local control.

Study of CRD, RBD, LSD and factorial designs- their applications in Pharmacy research with examples – Problem Solving

UNIT V

Analysis of Variance (ANOVA) – one way, two way and three way – principles and applications in pharmacy research- Problem Solving

Optimisation Techniques: Optimisation Techniques based on Factorial Experiments - Problem Solving.

Recommended Books:

1. Fundamentals of Biostatistics by Khan & Khanum, Ukaaz Publications, Hyderabad
2. Theory & Practice of Industrial Pharmacy by Leon Lachman and Others
3. Remingtons Practice of Pharmaceutical sciences, (Latest Edition)
4. Principles of Biostatistics by Marcello Pagnano, Published by Brooks/Cole, (Saurabh Printers Pvt. Ltd)
5. Introduction To Biostatistics – A text book of biometry By Pranab Kumar Banerjee

PAPER 103: ADVANCED PHARMACEUTICAL ANALYSIS-I

UNIT-I

1. Good Laboratory practices (GLP), Laboratory maintenance, standard operating procedures (SOPS), Validation of analytical instruments and methods. – Quality Control Laboratory Regulatory requirements

UNIT-II

1. Theory, Instrumentation and application with regard to drug analysis, decomposition product identification and estimation and metabolite analysis based on the following:

a) Ultraviolet visible spectrophotometry

b) Infrared Spectrophotometry

c) Fluoremetry, Nephelometry and Turbidimetry

UNIT-III

1. Polarography.

2. Flame emission spectroscopy and atomic absorption spectroscopy. Principle, Instrumentation and applications in Pharmacy.

UNIT-IV

1. Thermal Methods of Analysis: Theory of Thermo gravimetric analysis (TGA), Differential Thermal analysis (DTA), Differential Scanning Calorimetry (DSC) and Thermo Mechanical Analysis (TMA).

2. An advanced study of non - aqueous titrations involving the following:

a) Primary, Secondary and Tertiary amines

b) Halogenated salts and bases

c) Acidic substances

d) Assays of official drugs in IP 1996 by non - aqueous titrimetry

e) Aquametry: Determination of water by titration with Karl Fischer Reagent (KFR).

UNIT-V

1. Principles and pharmaceutical applications of redox titrations involving:

a) Potassium lodate / bromate titrations

h) Ceric ammonium sulphate titrations

c) Tanus Chloride titration

d) Examples of assays of official drugs in IP 1996.

2. Principles and Pharmaceutical applications of complexometric titrations involving:

a) Direct titration of Polymetallic system with Sodium EDTA

b) Back titration with sodium EDTA

c) titration involving the displacement of one complex by another

d) PM indicators

e) Examples of assays official drugs in IP 1996.

TEXT BOOKS

1. Practical Pharmaceutical Chemistry Vol. 1 &II by Beckett & Stenlake.
2. Instrumental Methods of Analysis by Scog and West.
3. Instrumental Methods of Analysis by B.K.Sharma
4. Vogel's text book of Quantitative Chemical Analysis.
5. Instrumental methods of Analysis by Willard & Merrit.
6. A text book of Pharmaceutical Analysis by K. A. Conners.

REFERENCE BOOKS

1. I.P.
2. B.P.
3. U.S.P.
4. Remington's Pharmaceutical Sciences.
5. Spectroscopy b Silversterin

PAPER 104: CHROMATOGRAPHIC AND OTHER SPECIAL TECHNIQUES

UNIT-I

An advanced study of the following and their applications.

Basic principle and separation by Column chromatography, thin layer chromatography, paper chromatography and ion exchange chromatography.

UNIT-II

Gas Chromatography: Introduction, theory, column operation, instrumentation and detection, GCMS.

UNIT-III

High Pressure Liquid Chromatography: Principle, Instrumentation procedure, solvents used, elution techniques, LCMS and applications.

UNIT-IV

1. HPTLC and Supercritical Fluid Chromatography (SFC): Principle, instrumentation procedure, elution technique and pharmaceutical applications.
2. H.P.C.P.C

UNIT-V

1. Electrophoreses (gel and capillary)

2. Radio immuno assay and related immuno assays — RIA, ELISA

TEXT BOOKS

1. Instrumental Methods of Analysis by Scog and West.
2. lnstrumental Mcthods of Analysis by B.K.Sharma
3. Instrumental methods of Analysis by Willard & Merrit.
4. High Performance Liquid Chromatography by P. D. Sethy.
5. Liquid Chromatography-Mass Spectrometry, Third Edition by by Wilfried M.A. Niessen

REFERENCE BOOKS

1. USP
2. Remington's Pharmaceutical Sciences.
3. Spectroscopy by Silversterin
4. Instrumental methods of Analysis by Hibart. H. Willard.

PAPER 105: ADVANCED PHARMACEUTICAL ANALYSIS –I

1. Use of spectrophotometer for analysis of Pharmacopoeial compounds and their formulations.
2. Use of fIuorimeter for analysis of Pharmacopoeial compounds.
3. Use of Flame photometer for analysis of Na, K & Ca etc in Biological fluids and formulations.
4. Use of Nephelo- Turbidimetric analysis of dispersions and limit tests.
5. Assays involving following procedures: Non – Aqueous, Diazotisation, Complexation and Redox titrations.
6. Official (I.P) Assays based on theory.

TEXT BOOKS

1. Practical Pharmaceutical Chemistry Vol. 1 &II by Beckett & Stenlake.
2. Instrumental Methods of Analysis by Scog and West.
3. Instrumental Methods of Analysis by B.K.Sharma
4. Vogel's text book of Quantitative Chemical Analysis.
5. Instrumental methods of Analysis by Willard & Merrit.
6. A text book of Pharmaceutical Analysis by K. A. Conners.

REFERENCE BOOKS

1. I.P.
2. B.P.
3. U.S.P.
4. Remington's Pharmaceutical Sciences.
5. Spectroscopy b Silversterin

PAPER 106: CHROMATOGRAPHIC AND OTHER SPECIAL TECHN1QUES LAB

1. Experiments on Electrophoresis.
2. Experiments of Chromatography:
    a) Ascending technique
    b) Descending technique
    c) Circular technique
3. Experiments using HPLC & GC.

TEXT BOOKS

1. Instrumental Methods of Analysis by Scog and West.
2. lnstrumental Mcthods of Analysis by B.K.Sharma
3. Instrumental methods of Analysis by Willard & Merrit.
4. High Performance Liquid Chromatography by P. D. Sethy.

REFERENCE BOOKS

1. USP
2. Remington's Pharmaceutical Sciences.
3. Spectroscopy by Silversterin
4. Instrumental methods of Analysis by Hibart. H. Willard.

II SEMESTER

PAPER 201 : ADVANCED PHARMACEUTICAL ANALYSIS-II

UNIT-I

1. A detailed study of the principles, instrumentation and applications of the following instrumental analysis:
   i. Nuclearinagnetic resonance spectrometry - ^{1}H NMR ,2D NMR, COSY, ^{13}CNMR, DEPT Experiments
   ii. Mass spectroscopy.

UNIT-II

1. A detailed study of the principles, instrumentation and applications of the following instrumental analysis:
   i. X-ray fluorescence spectrometry
   ii. Raman Spectroscopy
   iii. Inductively coupled plasma - atomic emission spectroscopy
   iv. Electron spin resonance spectroscopy (ESR)

UNIT-III

1. A detailed study of the various principles and procedures involved in the qualitative and quantitative analysis of pharmaceutical preparations and dosage forms containing the following groups of drugs included in IP (Biological and microbiological methods excluded)
   a) Analgesics and antipyietics b) l3arbiturates c) Sulphonamidcs
   d) Antibiotics e) Steroidal hormones f) Vitamins
   g) Alkaloids

UNIT-IV

1. A detailed study of the principles and procedures involved in the qualitative and quantitative analysis of pharmaceutical preparations and dosage forms using the following reagents and reactions.
   i) Oxidative coupling reactions using MBTH (3 - methyl -2 benzothiazolinone hydrazone hydrochloride)
   ii) Diazotisation followed by coupling
   iii) Oxidation followed by complexation.

2. A detailed study of the principles and procedures involved in the qualitative and quantitative analysis of pharmaceutical preparations and dosage form using the following reagents and reactions
   i) Oxidation followed by charge transfer reaction.
   ii) Condensation reactions using the reagents Para Dimethyl Amino Benzaldehyde (PDAB), Para Dimethyl Amino Cinnamaldehyde (PDAC), Folin's reagent and Gibb's reagent
   iii) Folin-ciocalteu reagent (FC reagent)

UNIT- V

1. General methods for quality control of various types of official formulation- tablets, capsules, suspensions, ointments and injections.
2. Testing of containers and closures (glass, metal, rubber and plastic) for pharmaceutical preparations as per the I.P.

TEXT BOOKS

1. Instrumental methods of analysis by Scog and West.
2. Chemical Analysis - Modem Instrumentation methods and techniques by Wiley.
3. Instrumental methods of analysis by Willard Merrit Dean &.
4. A text book of Pharmaceutical Analysis by K.A. Conners (John Wiley)
5. Pharmaceutical analysis edited by Highuchi and Brochman

REFERENCE BOOKS

1. Spectrometric identification of organic compounds by Silverstein (7th Edition) 1981
2. Hand book of Instrumental techniques for analtica1 chemistry edited by Frank sett by Prentice Hall Ine.
3. IP
4. BP
5. USP

Paper 202 : QUALITY CONTROL OF PHARMACEUTICALS

UNIT- I

In Process Quality Control and Process Analytical Technology (PAT)

In process control during component manufacture – Solid dosage forms – Liquid dosage forms – Semi solid dosage forms – Inhalations – Sterile solutions – Novel drug delivery systems – Various IP, BP, USP Methods.

Implementation of process analytical technologies in the industrial settings – Generalized process analytical works – PAT applications – Chemometrics – Online applications in pharmaceutical industries.

UNIT-II

Performance Evaluation Methods

In vitro dissolution studies for solid dosage forms – In vitro drug dissolution testing models – method interpretation of dissolution data – Bioavailability studies and bioavailability testing protocol and procedures – In vivo methods of evaluation and statistical treatment – In vitro invivo correlation (F2 Factor) – Various invitro and in vivo models.

UNIT-III

Biological standardisation

Biological Standardization: General Principles, Scope & limitations of Bioassays. Bio-assays of some Official Drugs.

Pyrogen - chemistry and properties of bacterial pyrogens and endotoxins.

Mechanisms of action of pyrogens. Pharmaceutical aspects, pyrogen test of IP compared to that of BP & USP. Interpretation of data, Comparison of LAL and other pyrogen tests.

Analysis of drugs from biological samples including, selection of biological sample, extraction of drugs by various methods as LLE, SPE and Membrane filtration. Microbiological Limit Tests, Tests for effectiveness of antimicrobial preservatives.

UNIT-III

Bioassays

Detailed study of principles & procedures involved in bio assay of.

(a) Heparin, insulin, posterior pituitary

(b) Diphtheria, typhoid

Principles and Procedures involved in Biological tests of the following.

(i) Living contaminants in vaccines.

(ii) Histamine like substances

(iii) Determine of toxic elements

UNIT-IV

Herbal Products Analysis

Study of method procedure, drugs of formulations standard requirements of herbal medicines, traditional and folk remedies, preparation & their quality, safety and efficaly assessment & use for acceptance by FDA.

Recommended Books

1. Brewer, R. F., “Design of Experiments for Process Improvement and Quality Assurance”, Narora Publishing House, 1996.
2. Sethi,P.D., “Quantitative Analysis of Drugs in Pharmaceutical Formulations”, 3rd Edition, C.B.S. Publishers and Distributors, 2003.
3. Bakeev, K.A., “Process Analytical Technology”, Blackwell Publishers, 2006
5. Indian and British Pharmacopoeia

PAPER 203: QUALITY ASSURANCE OF PHARMACEUT1CALS- I

UNIT-I

1. Concept of Quality assurance, total quality management, philosophy of GMP, CGMP and GLP.

2. Organization and personnel, responsibilities, training hygiene - Premises: Location, design, plan layout, construction, maintenance and sanitations, environmental control, sterile areas, control of contamination.

UNIT-II

Equipments: Selection, purchase specifications, maintenance, clean in place, sterilize in place - Raw materials: Purchase specifications, maintenance of stores, selection of vendors, controls and raw materials.

UNIT-III

1. Manufacture and controls on dosage forms, manufacturing documents master formula, batch formula records, standard operating procedures, quality audits of manufacturing processes and facilities - In process quality control on various dosage forms: sterile, biological products and non sterile, standard operating procedures for various operations like cleaning, filling, drying, compression, coating, disinfection, sterilization, membrane filtration etc.

Guidelines for Quality Assurance of Human Blood products and large volume parenterals.

2. Packaging and labeling controls, line clearance and other packaging materials.

UNIT-IV

1. Quality Control Laboratory: Responsibilities, good laboratory practices, routine controls, instruments, protocols, non-clinical testing, controls on animal house, data generation and storage, quality control documents, retention samples, records, audits of quality control facilities - Finished products release: quality review, quality audits, and batch release document.

UNIT-V

1. Distribution and Distribution records: Handling of returned goods, recovered materials and reprocessing.

2. Complaints and recalls, evaluation of complaints, recall procedures, related records and documents.

TEXT BOOKS

1. The International Pharmacopoeia Vol. 1,2,3,4, 3rd edition General methods of analysis quality specifications for Pharmaceutical substances, Excipients, dosage forms.

2. Quality Assurance of Pharmaceuticals: A compendium of guidelines and related material Vol. 1 and Vol. 2., WHO, (1999).

3. GMP-Mehra

4. Pharmaceutical Process validation by Berry and Nash

REFERENCE BOOKS

1. Basic tests for Pharmaceutical substances - WHO (1988)
2. Basic tests for Pharmaceutical substances - WHO (1991)
3. How to practice GMP's – P.P.Sharma
4. The Drugs and Cosmetic Act 1940- Vijay Malik
5. Q.A Mannual by D.H.Shah
6. SOP Guidelines by D.H.Shah
7. Quality Assurance Guide by OPPI

PAPER 204: DRUG REGULATORY AFFAIRS:

(Paper Common for all Specializations)

Unit - I

Formulation development: Regulatory requirements involved in the preformulation studies, solid, liquid and semi-solid dosage forms, controlled release preparations, injections, ocular preparations as per the European community, United States and Indian regulatory authorities

Unit - II

Manufacturing: Regulatory requirements as per European community, United States and Indian regulatory authorities for manufacturing information, manufacturing formula, process, validation of manufacturing process, equipment, documentation, inspection requirement of regulatory guidelines for active ingredients, data requirement for new drug, International aspects of Excipients, approval as per guidelines of all the territories. Regulatory guidelines for packaging materials, test and evaluation of packaging materials, biological test, elastometer test, microbiological test and evaluation of closures.

Unit - III

Stability testing: Scientific and technical background to the design of stability testing regulatory requirements as per European community, United States and Indian regulatory authorities for testing of new active substances, bulk active drug substances, dosage form in their final packaging. Extension of shelf-life after authorization of drug international harmonization and current guidelines. Regulatory affairs in respect of residual solvents as per the ICH guidelines, analytical method validation, pharmacokinetic and toxicokinetic validation.

Biopharmaceutics: Different testing parameters and standards as per regulatory requirements of European community, United States and Indian regulatory authorities with respect to factors related to formulation, dosage form, manufacturing process, stability and storage.

Unit - IV

Preclinical aspects of Biopharmaceutics: Current guidelines and developments as per regulatory requirements of European community, United States and Indian regulatory authorities in respect of clinical bioavailability , study design, presentation documentation and statistical analysis

Clinical pharmacology and Pharmacodynamics: Regulatory guidelines as per European community, United States and Indian regulatory authorities on clinical study design, documentation, presentation and interpretation. Clinical trials: Definition, phase I, phase II, phase III and phase IV studies, design documentation, presentation and interpretation, statistical analysis of clinical data and factorial design.

Unit - V

Intellectual property rights and patents: Introduction, purpose, international scenario and Indian scenario, guidelines as per European community, United States and Indian regulatory authorities, documentation, presentation and application, procedure for obtaining and writing a patent and patenting rules and regulations

References:

1. Quality Assurance Guide by Organization of Pharmaceutical producers of India.
2. Drug formulation manual by D.P.S. Kohli and D.H.Shah. Eastern publishers, New Delhi.
3. How to practice GMPs by P.P.Sharma. Vandhana Publications, Agra.
4. Pharmaceutical Process Validation by Fra. R. Berry and Robert A. Nash.
5. Pharmaceutical Preformulations by J.J. Wells.
6. Applied production and operations management by Evans, Anderson, Sweeney and Williams.
7. Basic Principles of Clinical Research and Methodology by Gupta.
8. Biopharmaceutics and Clinical Pharmacokinetics-An introduction; 4th edition, Revised and expanded by Robert. E. Notari, Marcel Dekker Inc, New York and Basel, 1987

PAPER 205 - ADVANCED PHARMACEUTICAL ANALYSIS -II LAB

1. Estimation of following classification of drugs using different analytical methods.
a) Analgesics and Antipyretics b) Barbiturates c) Sulfonamide drugs
d) Antibiotics e) Steroidal hormones f) Vitamins
g) Alkaloids
2. Estimation of different classification of drugs using the following reagents:
a) MBTH b) PC reagent c) $FeCl_3$ and 1,10- phenanthroline
d) $FeCl_3$ & K_3 Fe $(CN)_6$ e) BM reagent f) p-dimethylamine benzaldehyde
g) p-dimethylamino cinnamaldehyde h) N-bromo succinimide-metol/sulphanilamide.
3. Quality control test for official formulations.
4. Testing of containers and closures (glass, metal, rubber and plastic) for official (IP) pharmaceutical preparations.

PAPER 206 - QUALITY CONTROL OF PHARMACEUTICALS LAB

Practicals based on the Theory