

## M.PHARMACY

### QUALITY ASSURANCE AND REGULATORY AFFAIRS

#### I SEMESTER

Paper 101	-	Modern Analytical Techniques-
Paper 102	-	Research Methodologies
Paper 103	-	Quality Control of Pharmaceuticals
Paper 104	-	Indian Drugs Regulatory Aspects
Paper 105	-	Quality Control of Pharmaceuticals - LAB
Paper 106	-	Indian Drugs Regulatory Aspects - LAB
Paper 107	-	Seminar

#### II SEMESTER

Paper 201	-	International Drug Regulatory Aspects
Paper 202	-	Advanced Pharmaceutical Analysis
Paper 203	-	Quality Assurance of Pharmaceuticals
Paper 204	-	Drug Regulatory Affairs
Paper 205	-	International Drug Regulatory Aspects - LAB
Paper 206	-	Advanced Pharmaceutical Analysis - 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**

**QUALITY ASSURANCE AND REGULATORY AFFAIRS**

**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 – 103	Quality Control of Pharmaceuticals	40	60			100	3
Paper – 104	Indian Drugs Regulatory Aspects	40	60			100	3
Paper – 105	Quality Control of Pharmaceuticals			40	60	100	2
Paper – 106	Indian Drugs Regulatory Aspects			40	60	100	2
Paper – 107	Seminar					100	2
	TOTAL					700	18

**SECOND SEMESTER**

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

**THIRD AND FOURTH SEMESTERS**

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

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

# **M.PHARM SYLLABUS FOR QUALITY ASSURANCE AND REGULATORY AFFAIRS**

## **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. Connors.

#### **REFERENCE BOOKS**

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

**Text & Reference Books:**

1. Fundamentals of Biostatistics by Khan & Khanum, 3<sup>rd</sup> Revised Edition, 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)

## **PAPER 103 : 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 in vivo 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 efficacy 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 104 - INDIAN DRUGS REGULATORY ASPECTS**

### **UNIT- I**

A study of regulatory aspects that affect drug product design, manufacture and distribution in India with special emphasis on the detailed study of the following Acts / Laws (with latest amendments)

- Package commodities act
- Competition council of India
- Right to information act
- National Pharmaceutical Pricing Authority (NPPA) – Power to fix the maximum sale prices of bulk drugs specified in the First Schedule, calculation of retail price of formulation, power to revise price of bulk drugs and formulations, display of prices of non-scheduled formulations and price list thereof. Study of different forms to be used for submission of these approvals.

### **UNIT- II**

**Introduction to IPRs :** Intellectual property (IP) versus conventional property. Introduction to 8 different IP mechanisms – patents, industrial designs, and layout designs, plant varieties, geographical indications, copyright, trademark, trade secrets; their characteristics, properties. usefulness of patents for researchers. Factors affecting choice of IP protection; penalties for violation / infringement. IPRs vs. Regulatory affairs- similarities and differences.

**Patenting in India :** Development of IP law in India. Patent legislation and introduction to current IP laws in India. Amendments in Indian Patent laws and their significance; Requirement for patenting- novelty, inventive step (non obviousness) and industrial application (utility). Patent specification & claims, patent infringement. Procedure for filing patent in India- provisional, complete, divisional, additional and conventional patent applications; forms and fee. Prior art search and sources of patent information – free and paid databases. Patent analysis and land-scaping. Patent Search Maps. Infringement analysis. Concepts of Patent writing in India. Patent cooperation treaty (PCT) route of filing for International patents.

### **UNIT- III**

Schedule M, M1, M2 & U general requirements and special provisions, DCGA & Central Drugs Standard Control Organization (CDSCO) regulatory requirements and other legal provisions related to production of Active Pharmaceutical Ingredients (APIs), other raw materials (including packaging materials) used in drugs & cosmetics.

Schedule M, M1, M2 & U general requirements and special provisions, DCGA & Central Drugs Standard Control Organization (CDSCO) regulatory requirements and other legal provisions related to production aspects of various drugs & cosmetic formulations (solid, parenteral and semi solid preparations).

Pilot plant scale- up techniques: Pharmaceutical pilot plant, pilot plant design, case studies for above preparations. Basic requirements for design of product, facility, equipment selection and personnel.

Schedule M, M1, M2 & U general requirements and special provisions DCGA & Central Drugs Standard Control Organization (CDSCO) regulatory requirements and other legal

provisions related to quality control & quality assurance aspects of various drugs & cosmetic formulations (solid, parenteral and semi solid preparations).

#### **UNIT- IV**

General requirements and special provisions, DCGA & Central Drugs Standard Control Organization (CDSCO) regulatory requirements and other legal provisions related to marketing of various drugs & cosmetic formulations (solid, parenteral and semi solid preparation). Introduction to uniform code of marketing practices for the Indian pharmaceutical industry (UCPMP).

Indian Good Clinical Practices guidelines: National regulatory requirements for pharmaceutical development regarding clinical research practices. Current issues in GCP; standards for design, conduct, performance, monitoring, auditing, recording, analysis, and reporting of clinical trials. Schedule Y of Indian Drugs and Cosmetics Act 1940, Role of Regulatory affairs in Developing clinical trial protocols, Clinical phase, Preclinical Phase, Manufacturing phase and Marketing Phase.

#### **UNIT- V**

Hierarchy and working flow of DCGA in India. Regulations and documentation related to manufacturing, cleaning methods, retention samples and records, quality control, batch release documents, distribution records, complaints and recalls.

WHO certification, Trademarks and copyrights. National Accreditation Board for testing and Calibration Laboratory (NABL) certification and accreditation procedure. The International Organization for Standardization (ISO) 9000 series of quality systems standards, ISO 14000.

#### **References:**

1. Drugs and Cosmetics Act, 1940 and its rules, published by Ministry of health and family welfare, Government of India.
2. Pharmaceutical Jurisprudence, G.K. Jani.
3. The Pharmaceutical Regulatory Process, 2nd ed. – Ira R. Berry, Robert P. Martin
4. Medical Product Regulatory Affairs: Pharmaceutical, Diagnostics, Medical Devices – John J. Tobin and Gary Walsh.
5. FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices and Biologics, 2nd ed. – Douglas J. Pisano and David S. Mantus
6. Good Drug Regulatory Practices: a Regulatory Affairs Quality Manual (Good Drug Development Series) – Helene I. Dumitriu.
7. Pharmaceutical Patent Law – John R. Thomas.
8. Original laws published by Govt. of India.
9. Text Book of Forensic Pharmacy by Mithal B. M.; Vallabh Prakashan, New Delhi.
10. Laws of Drugs in India by Hussain.
11. Text Book of Forensic Pharmacy by Jain N. K.; Vallabh Prakashan, New Delhi.

## **PAPER 105 - QUALITY CONTROL OF PHARMACEUTICALS LAB**

### **Practicals based on the Theory**

## **PAPER 106 - INDIAN DRUGS REGULATORY ASPECTS - LAB**

1. Testing of glass, rubber, plastic & metal packaging materials and preparing document for submission for approval.
2. Stability testing of an API, a pharmaceutical excipient, pharmaceutical dosage forms (solid, parenteral & semi solid) as per regulatory requirements and preparing required documents for submission
3. Quality control testing of finished product (solid, parenteral & semi solid dosage forms) as per Indian Pharmacopoeial requirements and preparing required documents for submission.
4. Patent writing for a given modification in the composition of a dosage form (minimum of 2 protocols).
5. Preparation of documents for submitting a patent file through Patent cooperation treaty (PCT) route.
6. Preparation of Dossiers to be submitted to the CDSCO/DCGA for a solid/parenteral/ semi solid dosage forms.

## 2<sup>nd</sup> SEMESTER

### **PAPER 201 - INTERNATIONAL DRUG REGULATORY ASPECTS**

#### **UNIT- I**

**Generic drug product development:** Introduction, Hatch-Waxman update, Drug product performance- in vitro, Abbreviated New Drug Application (ANDA) Regulatory Approval Process, paragraph IV drug product application. Bioequivalence and drug product assessment- in vivo, scale- up, post approval changes, post marketing surveillance, outsourcing Bioavailability and Bioequivalence studies to Contract Research organizations. Formats for marketing authorization submission to WHO, USFDA, EU. Data privacy Protection, Pharmaceutical Labeling, Advertising and Promotion, Risk Management in regulatory affairs.

**Regulatory requirements for product approvals:** Active Pharmaceutical Ingredients, Biologics, novel therapies, special categories [Over - the - counter (OTC) products, herbal medicines and Homeopathics]. Obtaining New Drug Application (NDA), ways and means of US Registration for foreign drugs, Chemistry, Manufacturing and controls (CMC), Post approval Regulatory affairs, Regulation for combination products (Controlled release systems), medical devices, Environmental concerns and regulations. 21 Code of Federal Regulations (CFR) Part 11 and LIMS (Laboratory Information Management System).

#### **UNIT- II**

**FDA Approval indications and other considerations:** Data procession for Global submission, Text and Tabular exposition- Common Technical Document (CTD)/ electronic Common Technical Document (eCTD) format, working with contract research organization (CRO), industry and FDA liaison, role of European Commission Competent Authorities and Notified Bodies and USFDA authorities.

**Nonclinical drug development:** Global submission of Investigational New Drug application (IND), New Drug application (NDA), Abbreviated New Drug Application (ANDA), Investigational medicinal product Dossier (IMPD) & Investigator Brochure (IB), new product applications for global pharmaceutical product approvals, US NDA vs. Global CTD Formats, ANDA & Supplemental Abbreviated New Drug Application (SNDA), CTD and eCTD for registration of pharmaceuticals for Human use, combination products & controlled release systems.

**Centralized procedure for marketing authorization:** legal basis – scope. Procedure for submission of application – preauthorization, inspections (GMP inspection) – pre authorization inspection (GCP inspection) – Scientific evaluation of the application – CPMP (Committee for Proprietary Medicinal Products) opinion and follow up action.

#### **UNIT- III**

Harmonization of regulatory requirements- The International Conference on Harmonization (ICH) process, guidelines to establish quality, safety and efficacy (carcinogenicity studies - need for carcinogenicity studies of pharmaceuticals and testing for carcinogenicity of pharmaceuticals, Genotoxicity- a standard battery for Genotoxicity testing of pharmaceuticals) of drug substances and products. Study of ICH common technical documents,

harmonization of pharmacopoeial standards. Health Insurance Portability and Accountability Act of 1996 (HIPAA)- A new requirement to clinical study process, Code of Federal Regulations (CFR)/ International Conference on Harmonization (ICH) / EU GCP obligations of Investigators, sponsors & monitors.

#### **UNIT- IV**

Stability Testing of New Drug Substances and Products Stability Testing: Photo-stability testing of new drug substances and products, stability testing for new dosage forms, bracketing and matrixing designs for stability testing of new drug substances and products. Evaluation of stability data, impurities in new drug substances, impurities in new drug products, guidelines for residual solvents.

#### **UNIT- V**

Quality evaluation and batch release: change control, deviation-(planned and unplanned), corrective action and preventive action (CAPA), Handling of non-conformance, vendor evaluation process, out of specification (OOS), batch reconciliation and finished goods release, market recalls & market complaints.

Joint International Pharmaceutical Excipients Council (IPEC) – Pharmaceutical Quality Group (PQG) Good Manufacturing Practices guidelines for pharmaceutical excipients.

#### **References:**

1. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143
2. The Pharmaceutical Regulatory Process, Edited by Ira R. Berry Marcel Dekker Series, Vol.144
3. The Pharmaceutical Regulatory Process, Second Edition, Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences, Vol.185 Informa Health care Publishers.
4. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences, Vol.190.
5. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons. Inc.
6. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus.
7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance by Fay A. Rozovsky and Rodney K. Adams
8. HIPAA and Human Subjects Research: A Question and Answer Reference Guide by Mark Barnes, JD, LLM and Jennifer Kulynych, JD, PhD
9. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
10. Drugs: From Discovery to Approval, Second Edition by Rick Ng
11. New Drug Development: A Regulatory Overview, Eighth Edition by Mark Mathieu
12. Pharmaceutical Risk Management By Jeffrey E. Fetterman, Wayne L. Pines and Gary H. Slatko

13. Preparation and Maintenance of the IND Application in eCTD Format By William K. Sietsema
14. Medical Device Development: A Regulatory Overview by Jonathan S. Kahan
15. Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics, Medical Devices by John J. Tobin and Gary Walsh

## **PAPER 202 - ADVANCED PHARMACEUTICAL ANALYSIS**

### **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) Fluometry, 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 Iodate / bromate titrations
- b) 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. Connors.

**REFERENCE BOOKS**

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

## **PAPER 203 - QUALITY ASSURANCE OF PHARMACEUTICALS**

### **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**

1. **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, 3<sup>rd</sup> 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

**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 - INTERNATIONAL DRUG REGULATORY ASPECTS - LAB**

1. The general stages of drug development from R & D to marketing.
2. List the various types of manufacturer – FDA interactions that can occur during the drug development process.
3. Requirements for registration of ANDA as per ICH CTD/eCTD format.
4. Preparation of documents required for paragraph IV drug product application.
5. The general process by which new molecular entities (NMEs) are identified through pharmaceutical approaches.
6. Types of IND applications and structures of each type.
7. Requirements to complete an IND application and IND review process.
8. Requirements for a new drug application (NDA) & NDA submission process.
9. FDA's review of submitted NDA application/FDA's requirements for changes to an approved NDA
10. Clinical trial protocol preparation / clinical data requirements for approval of controlled release NDA
11. Post NDA approval responsibilities of a sponsor.
12. General study of ICH guidelines with special reference to ICH Q7, Q8, Q9 and Q10
13. Compliance requirements for bioavailability & bioequivalence studies.
14. Patent challenge/ non infringement case studies.
15. Qualification of disintegration test apparatus/friability test apparatus/dissolution test apparatus
16. Qualification of UV-Vis spectrophotometer.
17. Comparison of D & C Act with that of other regulations such as USFDA, UKMCA, EDQM, South Africa MCC, Brazilian ANVISA, Australian TGA

## **Paper 206 - ADVANCED PHARMACEUTICAL ANALYSIS - LAB**

1. Use of spectrophotometer for analysis of Pharmacopoeial compounds and their formulations.
2. Use of fluorimeter 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. Connors.

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2. B.P.
3. U.S.P.
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### **TEXT BOOKS**

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