KERALA UNIVERSITY OF HEALTH SCIENCES

Thrissur - 680596

SYLLABUS

POST GRADUATE COURSE IN PHARMACY

Master of Pharmacy (M. Pharm.)

INDUSTRIAL PHARMACY	MIP
KUHS Course Code	533

(2022-23 Academic year onwards)

2022

Course of study for M.Pharm. I & II Semester

MIP	Industrial Pharmacy				
Course Code	**Course**	**Credit Hours**	**Credit Points**	**Hrs./wk**	**Marks**
Semester I					
MIP 101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MIP 102T	Pharmaceutical Formulation Development	4	4	4	100
MIP 103T	Novel Drug delivery systems	4	4	4	100
MIP 104T	Intellectual Property Rights & Regulatory Affairs	4	4	4	100
MIP 105P	Industrial Pharmacy Practical - I	12	6	12	150
-	Seminar/Assignment	7	4	7	100
Total		**35**	**26**	**35**	**650**
Semester II					
MIP 201T	Advanced Biopharmaceutics and Pharmacokinetics	4	4	4	100
MIP 202T	Scale up and Technology Transfer	4	4	4	100
MIP 203T	Pharmaceutical Production Technology	4	4	4	100
MIP 204T	Entrepreneurship Management	4	4	4	100
MIP 205P	Industrial Pharmacy Practical – II	12	6	12	150
-	Seminar /Assignment	7	4	7	100
Total		**35**	**26**	**35**	**650**

Course of study for M. Pharm. III & IV Semester

Course Code	**Course**	**Credit Hours**	**Credit Points**	**Marks**
Semester III				
MRM 301T	Research Methodology and Biostatistics	4	4	100
-	Journal Club	1	1	25
-	Discussion / Presentation (proposal presentation)	2	2	25
-	Research Work	28	14	350
Total		**35**	**21**	**500**
Semester IV				
-	Journal Club	1	1	25
-	Pre submission Discussion / Presentation	3	3	75
-	Research Work	31	16	400
Total		**35**	**20**	**500**

INDUSTRIAL PHARMACY (MIP)

SEMESTER - I

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPT 101T)

SCOPE

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

OBJECTIVES

Upon completion of the course, student shall be able to know about

- Chemicals and excipients
- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills for handling of the instruments

THEORY **60 Hrs**

1. **a. UV-Visible spectroscopy:** Introduction, Theory, Laws, Instrumentation 10 Hrs associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy.

   b. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation.

   c. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

   d. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

2. **NMR spectroscopy:** Principle, Instrumentation, 10 Hrs Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR, Applications of NMR spectroscopy.

3. **Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, 9 Hrs Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.

4. **Chromatography:** Principle, apparatus, instrumentation, chromatographic 9 Hrs parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following:
   a) Thin Layer chromatography
   b) High Performance Thin Layer Chromatography
   c) Ion exchange chromatography
   d) Column chromatography
   e) Gas chromatography
   f) High Performance Liquid chromatography
   g) Ultra High Performance Liquid chromatography
   h) Affinity chromatography
   i) Gel Chromatography

5. a.Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: 9 Hrs

i) Paper electrophoresis ii) Gel electrophoresis iii) Capillary electrophoresis iv) Zone electrophoresis v) Moving boundary electrophoresis vi) Iso electric focusing

b.X ray Crystallography: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.

6. a. Potentiometry: Principle, working, Ion selective Electrodes and Application of potentiometry. 9 Hrs

b. Thermal Techniques: i) Differential scanning calorimetry (DSC): Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications.

ii) Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). iii)Thermo Gravimetric Analysis (TGA): Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.

7. Immunological assays: RIA (Radio immuno assay), ELISA, Bioluminescence assays. 4 Hrs

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, 6th Edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman,5th Edition, Eastern Press, Bangalore, 1998.
3. Instrumental Methods of Analysis - Willards, 7th Edition, CBS publishers.
4. Practical Pharmaceutical Chemistry - Beckett and Stenlake, Vol II, 4th Edition, CBSPublishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3rd Edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P.D. Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis-Modern Methods-Part B-J.W. Munson, Vol 11, Marcel Dekker Series.
8. Spectroscopy of Organic Compounds, 2nd Edition, P.S. Kalsi, Wiley Eastern Ltd, Delhi.
9. Textbook of Pharmaceutical Analysis, K.A. Connors, 3rd Edition, John Wiley & Sons, 1982.

PHARMACEUTICAL FORMULATION DEVELOPMENT (MIP 102T)

Scope:

This course is designed to impart knowledge and skills necessary to train the students on par with the routine of Industrial activities in R&D and F&D.

Objectives:

On completion of this course it is expected that students will be able to understand-

- The scheduled activities in a Pharmaceutical firm.
- The pre formulation studies of pilot batches of pharmaceutical industry.
- The significance of dissolution and product stability

THEORY **60 Hrs**

1. Preformulation Studies: 12 Hrs

Molecular optimization of APIs (drug substances), crystal morphology and variations, powder flow, structure modification, drug-excipient compatibility studies, methods of determination.

2 a) Formulation Additives: Study of different formulation additives, factors influencing their incorporation, role of formulation development and processing, new developments in excipient science.

b) Design of experiments: Optimization techniques in Pharmaceutical Formulation: Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Quality by design- concept and applications. Statistical design, Response surface method, Contour designs, Factorial designs and application in product and process development.

3. Solubility: 12 Hrs

Importance, experimental determination, phase- solubility analysis, pH-solubility profile, solubility techniques to improve solubility and utilization of analytical methods – cosolvency, salt formation, complexation, solid dispersion, micellar solubilization and hydrotropy.

4. Dissolution: 12 Hrs

Theories, mechanisms of dissolution, in-vitro dissolution testing models – sink and non-sink. Factors influencing dissolution and intrinsic dissolution studies. Dissolution test apparatus – designs, dissolution testing for conventional and controlled release products. Data handling and correction factor. Biorelevent media, in-vitro and in-vivo correlations, levels of correlations.

5. Product Stability: 12 Hrs

Degradation kinetics, mechanisms, stability testing of drugs and pharmaceuticals, factors influencing-media effects and pH effects, accelerated stability studies, interpretation of kinetic data (API & tablets). Solid state stability and shelf life assignment. Stability protocols, reports and ICH guidelines.

REFERENCES

1. Lachman L, Lieberman HA, Kanig JL. The Theory and Practice of Industrial Pharmacy, 3 ed., Varghese Publishers, Mumbai 1991.

2. S inko PJ. Martin's physical pharmacy and pharmaceutical sciences, 5 ed., B.I. Publications Pvt. Ltd, Noida, 2006.

3. Lieberman HA, Landchman L, Schwartz JB. Pharmaceutical dosage forms: Tablets Vol. I-III, 2 ed., CBS Publishers & distributors, New Delhi, 2005.

4. Conners KA. A Text book of pharmaceutical analysis Wells JI. Pharmaceutical preformulation: The physicochemical properties of drug substances. Ellis Horwood Ltd., England, 1998.

5. Yalkowsky SH. Techniques of solubilization of drugs. Vol-12. Marcel Dekker Inc., New York, 1981

6. Dressman J, Kramer J. Pharmaceutical dissolution testing. Saurah printer pvt. Ltd., New Delhi,2005.

7. Sethi PD. Quantitative analysis of drugs in pharmaceutical formulations, 3 ed., CBS publications, New Delhi, 2008.
8. Carstensen JT, Rhodes CT. Drug stability principles and practices, 3rd Edition CBS Publishers & distributors, New Delhi, 2005.
9. Yoshioka S, Stella VJ. Stability of drugs and dosage forms, Springer (India) Pvt. Ltd., New Delhi, 2006.
10. Banker GS, Rhodes CT. Modern Pharmaceutics, 4th Edition, Marcel Dekker Inc, New York, 2005.
11. W. Grimm - Stability testing of drug products.
12. Mazzo DJ. International stability testing. Eastern Press Pvt. Ltd., Bangalore, 1999.
13. Beckett AH, Stenlake JB, Practical Pharmaceutical Chemistry, Part-I & II, 4th Edition, CBS Publishers & Distributors, New Delhi.
14. Indian Pharmacopoeia. Controller of Publication. Delhi, 1996.
15. British Pharmacopoeia. British Pharmacopoeia Commission Office, London, 2008.
16. United States Pharmacopoeia. United States Pharmacopeial Convention, Inc, USA, 2003.
17. Encyclopaedia of Pharm. Technology, Vol I – III.
18. Wells J. I. Pharmaceutical Preformulation: The physicochemical properties of drug substances, Ellis Horwood Ltd. England, 1988

NOVEL DRUG DELIVERY SYSTEMS (MIP 103T)

Scope:

This course is designed to impart knowledge and skills necessary to train the students in the area of novel drug delivery systems.

Objective:

On completion of this course it is expected that students will be able to understand,

- The need, concept, design and evaluation of various customized, sustained and controlled release dosage forms.
- To formulate and evaluate various novel drug delivery systems

THEORY **60 Hrs**

1. Concept & Models for NDDS: 10 Hrs

Classification of rate controlled drug delivery systems (DDS), rate programmed release, activation modulated & feedback regulated DDS, effect of system parameters in controlled drug delivery, computation of desired release rate and dose for controlled release DDS, pharmacokinetic design for DDS – intermittent, zero order & first order release.

Carriers for Drug Delivery: Polymers/co-polymers-Introduction, classification, characterization, polymerization techniques, application in CDDS/NDDS, biodegradable & natural polymers.

2. Study of Various DDS: 10 Hrs

Concepts, design, formulation & evaluation of controlled release oral DDS, Mucoadhesive DDS (buccal, nasal, pulmonary) Pulsatile, colon specific, liquid sustained release systems, Ocular delivery systems

3. Transdermal Drug Delivery Systems: 8 Hrs

Theory, design, formulation & evaluation including iontophoresis and other latest developments in skin delivery systems.

4. Sub-Micron Cosmeceuticals: 4 Hrs

Biology, formulation science and evaluation of various cosmetics for skin, hair, nail, eye etc and it's regulatory aspects.

5. Targeted Drug Delivery Systems: 10 Hrs

Importance, concept, biological process and events involved in drug targeting, design, formulation & evaluation, methods in drug targeting – nanoparticles, liposomes, niosomes, pharmacosomes, resealed erythrocytes, microspheres, magnetic microspheres. Specialized pharmaceutical emulsions – multiple emulsions, micro-emulsions.

6. Protein / Peptide Drug Delivery Systems: 6 Hrs

Concepts, delivery techniques, formulation, stability testing, causes of protein destabilization, stabilization methods.

7. Biotechnology in Drug Delivery Systems: 6 Hrs

Brief review of major areas-recombinant DNA technology, monoclonal antibodies, gene therapy.

8. New trends for Personalized Medicine: 6 Hrs

Introduction, Definition, Pharmacogenetics, Categories of Patients for Personalized Medicines: Customized drug delivery systems, Bioelectronic Medicines, 3D printing of pharmaceuticals, Telepharmacy.

REFERENCES

1. Novel Drug Delivery System, Y.W. Chein, Vol 50, Marcel Dekker, NY.
2. Controlled Drug Delivery Systems, Robinson, Vol 29, Marcel Dekker, NY.
3. Transdermal Controlled Systemic Medications, YW Chein, Vol 31, Marcel Dekker, NY.
4. Bioadhesive DDS, E. Mathiowitz, Vol 98, Marcel Dekker, NY.
5. Nasal System Drug Delivery, K.S.E. Su, Vol 39, Marcel Dekker, NY.
6. Drug Delivery Devices, Vol 32, P Tyle Marcel Dekker, NY.
7. Polymers for Controlled Drug Delivery, P.J. Tarcha, CRC Press.
8. Pharmaceutical Biotechnology, Vyas, CBS, Delhi.
9. Biotechnology of Industrial Antibiotics, E.J. Vandamme, Marcel Dekker, NY.
10. Protein Formulation & Delivery, E.J. McNally, Vol 99, Marcel Dekker, NY.
11. Drug Targeting, M.H. Rubinstein, John Wiley, NY.

INTELLECTUAL PROPERTY RIGHTS & REGULATORY AFFAIRS (MIP 104T)

Scope

This course is designed to impart knowledge and skills necessary to train the students to be on par with the routine of Industrial activities in drug regulatory affairs

Objectives

On completion of this course it is expected that students will be able to,

- Assist in Regulatory Audit process.
- Establish regulatory guidelines for drug and drug products
- The Regulatory requirements for contract research organizations

THEORY **60 Hrs**

1. Definition, Need for patenting, Types of Patents, Conditions to be satisfied by an invention to be patentable, Introduction to patent search. Parts of patents. Filling of patents. The essential elements of patent; Guidelines for preparation of laboratory note book, Non-obviousness in Patent. 10 Hrs

2. Documentation in pharmaceutical industry: 10 Hrs
Site Master File (SMF), Drug Master File (DMF). Master Formula Record, Batch Manufacturing Record and its calculations, Batch Reconciliation, Batch Packaging Records, Print pack specifications, Distribution records, Certificate of Analysis (CoA)

3. Regulatory requirements for product approval. 10 Hrs
NDA & ANDA, CTD & eCTD, ICH – Q, S, E, M Guidelines. Differences between generic drug products and brand name products.
Clinical Trials: Schedule Y, Clinical trial documentation, preparation of protocols, Different types of studies.

4. Role of GATT, TRIPS, and WIPO. 10 Hrs
Brief introduction to Trademark protection and WHO Patents. IPR's and its types,

5. Brief introduction to CDSCO. WHO, USFDA, EMEA, TGA, MHRA, MCC, ANVISA. 10 Hrs
Organisation, Responsibilities and Functioning of Drug regulatory authorities in India. Central and State Drug Licensing authorities

6. Regulatory requirements for contract research organization. 10 Hrs
Regulations for Biosimilars.

REFERENCES:

1. Pharmaceutical Process Validation: By Fra R. Berry and Robert A. Nash, Vol 57, 2nd Edition
2. Applied Production and Operation Management By Evans, Anderson and Williams
3. GMP for pharmaceuticals Material Management by K.K. Ahuja Published by CBS publishers
4. ISO 9000-Norms and explanations
5. GMP for pharmaceuticals- Willing S.H. Marcel and Dekker

INDUSTRIAL PHARMACY PRACTICAL - I (MIP 105P)

1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on HPLC / GC
4. Estimation of riboflavin/quinine sulphate by fluorimetry
5. Estimation of sodium/potassium by flame photometry
6. Effect of surfactants on the solubility of drugs.
7. Effect of pH on the solubility of drugs.
8. Stability studies of drugs in dosage forms at 25^{o}C, 60% RH and 40^{o}C, 75% RH
9. Compatibility evaluation of drugs and excipients (DSC & FTIR).
10. Preparation and evaluation of different polymeric membranes.
11. Formulation and evaluation of sustained release oral matrix tablet/ oral reservoir system.
12. Formulation and evaluation of microspheres / microcapsules.
13. Formulation and evaluation of transdermal drug delivery systems.
14. Design and evaluation of face wash, body- wash, creams, lotions, shampoo, toothpaste, lipstick.
15. Electrophoresis of protein solution.
16. Preparation and evaluation of Liposome delivery system.

SEMESTER – II

ADVANCED BIOPHARMACEUTICS & PHARMACOKINETICS (MIP 201T)

Scope:

This course is designed to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply Biopharmaceutics theories in practical problem solving.

Objectives

On completion of this course it is expected that students will be able to understand,

- The basic concepts in Biopharmaceutics and pharmacokinetics.
- The use of raw data and derive the pharmacokinetic models and parameters to best describe the process of drug absorption, distribution, metabolism and elimination.
- To critically evaluate Biopharmaceutics studies involving drug product equivalency.
- To design and evaluate dosage regimens of the drugs using pharmacokinetic and biopharmaceutical parameters.

THEORY **60 Hrs**

1. Absorption of Drugs: 10 Hrs

The Gastrointestinal Tract, Mechanism & Factors affecting drug absorption, Formulation and physicochemical factors. Rate-Limiting Steps in Drug Absorption, Role of the dosage form: Solution (elixir, syrup and solution) as a dosage form, Suspension as a dosage form, Capsule as a dosage form, Tablet as a dosage form. Physicochemical Nature of the Drug Formulation.

Transport model: Permeability-Solubility-Charge State and the pH Partition Hypothesis, Properties of the Gastrointestinal Tract (GIT), pH Microclimate Intracellular pH Environment, Tight-Junction Complex. Permeability: In-vitro, in-situ and In-vivo methods.

2. Biopharmaceutical Considerations in Drug Product Design and In Vitro Drug Product Performance: 10 Hrs

Biopharmaceutical Factors Affecting Drug Bioavailability, The Biopharmaceutics Classification System, Factors Affecting Drug Product Performance.

3. In Vitro Dissolution and Drug Release Testing, Dissolution rate, Dissolution process, 10 Hrs

Noyes–Whitney equation and drug dissolution, Factors affecting the dissolution rate. Solubility: Experimental methods. Compendial Methods of Dissolution, Alternative Methods of Dissolution Testing, Meeting Dissolution Requirements, Problems of Variable Control in Dissolution Testing Performance of Drug Products; In Vitro–In Vivo Correlation, Dissolution Profile Comparisons, Drug Product Stability Considerations in the Design of a Drug Product.

4. Drug Product Performance, In Vivo Bioavailability and Bioequivalence: 10 Hrs

Drug Product Performance, Purpose of Bioavailability Studies, Relative and Absolute Availability, Methods for Assessing Bioavailability, Design and Evaluation of Bioequivalence Studies, Study Designs, Crossover Study Designs, Evaluation of the Data, Bioequivalence Example, Study Submission and Drug Review Process, , Generic Biologics (Biosimilar Drug Products), Clinical Significance of Bioequivalence Studies, Special Concerns in Bioavailability and Bioequivalence Studies, Generic Substitution.

5. Pharmacokinetics: 10 Hrs

Basic considerations, Pharmacokinetic models, Compartment modeling: One compartment model- IV bolus, IV infusion, Extra-vascular; Multi Compartment model: Two compartment - model in brief, Non-Linear Pharmacokinetics: Cause of non-linearity, Michaelis – Menten equation, Estimation Kmax and Vmax.

Drug interactions: Introduction, the effect of protein-binding interactions, the effect of tissue-binding interactions, Cytochrome P450-based drug interactions, Drug interactions linked to transporters.

6. Application of Pharmacokinetics: 10 Hrs

Modified-Release Drug Products, Targeted Drug Delivery Systems and Biotechnological Products. Relationship between Pharmacokinetics including Pharmacodynamics: Generation of a pharmacokinetic–pharmacodynamic (PKPD) equation, Pharmacokinetic and pharmacodynamic, interactions. Pharmacokinetics and pharmacodynamics of biotechnology drugs: Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies.

REFERENCES

1. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi, 4th edition,Philadelphia, Lea and Febiger, 1991
2. Biopharmaceutics and Pharmacokinetics, A. Treatise, D.M. Brahmankar and Sunil B.J aiswal., Vallab Prakashan, Pitampura, Delhi
3. Applied Biopharmaceutics and Pharmacokinetics by Shargel. Land YuABC, 2nd edition, Connecticut Appleton Century Crofts, 1985
4. Textbook of Biopharmaceutics and Pharmacokinetics, Dr. Shobha Rani R. Hiremath,Prism Book
5. Pharmacokinetics by Milo Gibaldi and D. Perrier, 2nd edition, Marcel Dekker Inc.,New York, 1982
6. Current Concepts in Pharmaceutical Sciences: Biopharmaceutics, Swarbrick. J, Lea and Febiger, Philadelphia, 1970
7. Clinical Pharmacokinetics, Concepts and Applications 3rd edition by Malcolm Rowland and Thom~ N. Tozer, Lea and Febiger, Philadelphia, 1995
8. Dissolution, Bioavailability and Bioequivalence, Abdou. H.M, Mack Publishing Company, Pennsylvania 1989
9. Biopharmaceutics and Clinical Pharmacokinetics, An Introduction, 4th edition, revised and expanded by Robert. E. Notari, Marcel Dekker Inc, New York and Basel,1987.
10. Biopharmaceutics and Relevant Pharmacokinetics by John. G Wagner and M. Pemarowski, 1st edition, Drug Intelligence Publications, Hamilton, Illinois, 1971.
11. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996.
12. Basic Pharmacokinetics,1st edition, Sunil S Jambhekar and Philip J Breen, pharmaceutical press, RPS Publishing,2009.
13. Absorption and Drug Development- Solubility, Permeability, and Charge State, Alex Avdeef, John Wiley & Sons, Inc,2003.

SCALE UP AND TECHNOLOGY TRANSFER (MIP 202T)

Scope

This course is designed to impart knowledge and skills necessary to train the students to be on scale up, technology transfer process and industrial safety issues.

Objectives:

On completion of this course it is expected that students will be able to,

- Manage the scale up process in pharmaceutical industry.
- Assist in technology transfer.
- Establish safety guidelines, which prevent industrial hazards.

THEORY **60 Hrs**

1. Pilot plant design: 12 Hrs

Basic requirements for design, lay out, facility, equipment selection, for tablets, capsules, liquid orals, parenteral and semisolid preparations.

Scale up: Importance, Technology transfer from R & D to pilot plant to plant scale, process scale up for tablets, capsules, liquid orals, semisolids, parenteral, NDDS products – stress on formula, equipments, product uniformity, stability, raw materials, physical layout, input, in-process and finished product specifications, Steps in Technology transfer process, problems encountered during transfer of technology.

2. Validation: 12 Hrs

General concepts, types, procedures & protocols, documentation, Validation Master Plan. Analytical method validation, cleaning validation. Vendor qualification.

3. Equipment Qualification: 12 Hrs

Importance, DQ, IQ, OQ, PQ for equipments – autoclave, DHS, membrane filter, rapid mixer granulator, cone blender, FBD, tablet compression machine, liquid filling and sealing machine. Aseptic room validation.

4. Process validation: 12 Hrs

Importance, validation of mixing, granulation, drying, compression, tablet coating, liquid filling and sealing, sterilization, water process systems, environmental control.

5. Industrial safety: 12 Hrs

Hazards – fire, mechanical, electrical, chemical and pharmaceutical, Monitoring & prevention systems, safety management. industrial effluent testing & treatment. Control of environmental pollution. Solid waste management.

REFERENCES

1. Pharmaceutical process validation, JR Berry, Nash, Vol 57, Marcel Dekker, NY.
2. Pharmaceutical Production facilities, design and applications, by GC Cole, Taylor and Francis.
3. Pharmaceutical project management, T. Kennedy, Vol 86, Marcel Dekker, NY.
Varghese Publ. Bombay.
4. Tablet machine instruments in pharmaceuticals, PR Watt, John Wiley.
5. Pharmaceutical dosage forms, Tablets, Vol 1, 2, 3 by Lachman, Lieberman, Marcel Dekker, NY.

6. Pharmaceutical dosage forms, Parenteral medications, Vol 1, 2 by K.E. Avis, Marcel Dekker, NY.
7. Dispersed system Vol 1, 2, 3 by Lachman, Lieberman, Marcel Dekker, NY.
8. Subrahmanyam, CVS, Pharmaceutical production and Management, 2007, Vallabh Prakashan, Dehli.

PHARMACEUTICAL PRODUCTION TECHNOLOGY (MIP 203T)

Scope

This course is designed to impart knowledge and skills necessary to train the students to be on par with the routine of Industrial activities in Production

Objectives:

On completion of this course it is expected that students will be able to understand,

- Handle the scheduled activities in a Pharmaceutical firm.
- Manage the production of large batches of pharmaceutical formulations.

THEORY **60 Hrs**

1. Production Area design: 6 Hrs

selection of plant location, Design & layout of plant for bulk drugs & formulations. Process flow & Work Study. Concept of TQM, GLP, GMP, Orange book/guide.

2. Improved Tablet Production: 10 Hrs

Tablet production process, unit operation improvements, granulation and pelletization equipments, continuous and batch mixing, rapid mixing granulators, rota granulators, spheronizers and marumerisers, and other specialized granulation and drying equipments. Problems encountered.

Coating Technology: Process, equipments, particle coating, fluidized bed coating, application techniques. Problems encountered.

3. Parenteral Production: 10 Hrs

Area planning & environmental control, wall and floor treatment, fixtures and machineries, change rooms, personnel flow, utilities & equipment location, engineering and maintenance.

4. Lyophilization & Spray drying Technology: 10 Hrs

Principles, process, freeze-drying and spray drying equipments

5. Capsule Production: 10 Hrs

Production process, improved capsule manufacturing and filling machines for hard and soft gelatin capsules. Layout and problems encountered.

Disperse Systems Production: Production processes, applications of mixers, mills, disperse equipments including fine solids dispersion, problems encountered.

Packaging Technology: Types of packaging materials, machinery, labeling, package printing for different dosage forms.

6. Air Handling Systems: 8 Hrs

Study of AHUs, humidity & temperature control, air filtration systems, dust collectors. Validation of HVAC systems. Water Treatment Process: Techniques and maintenance – RO, DM, ultra – filtration, WFI.

7. Material handling of Raw materials, Packaging materials and Finished Goods. 6 Hrs

Pharmaceutical production planning & Control.

Applications of Computers in pharmaceutical production and packaging. Process automation technology (PAT) in Pharmaceutical manufacturing.

REFERENCES

1. The Theory & Practice of Industrial Pharmacy, L. Lachman. Varghese Publ. Bombay.
2. Modern Pharmaceutics by Banker, Vol 72, Marcel Dekker, NY.
3. Pharmaceutical Dosage Forms, Vol 1, 2, 3 by Lachman, Lieberman, Marcel Dekker, NY.
4. Pharmaceutical Dosage Forms, Parentral medications, Vol 1, 2 by K.E. Avis, Marcel Dekker, NY.
5. Pharmaceutical Production Facilities, design and applications, by G.C. Cole, Taylor and Francis.
6. Dispersed System Vol 1, 2, 3 by Lachman, Lieberman, Marcel Dekker, NY.
7. Product design and testing of polymeric materials by N.P. Chezerisionoff.
8. Pharmaceutical Project Management, T.Kennedy, Vol 86, Marcel Dekker, NY.
9. Packaging Pharmaceutical and Health Care, H.Lockhard.
10. Quality Control of Packaging Materials in Pharmaceutical Industy, Kharburn, Marcel Dekker, NY.
11. Freeze drying / Lyophilization of Pharmaceuticals & Biological Products, L. Ray, Vol 96, Marcel Dekker, NY.
12. Tablet Machine Instrumentation in Pharmaceuticals, PR Watt, Ellis Horwoods, UK.

ENTREPRENEURSHIP MANAGEMENT (MIP 204T)

Scope

This course is designed to impart knowledge and skills necessary to train the students on entrepreneurship management.

Objectives:

On completion of this course it is expected that students will be able to understand,

- The Role of enterprise in national and global economy
- Dynamics of motivation and concepts of entrepreneurship
- Demands and challenges of Growth Strategies and Networking

THEORY **60 Hrs**

1. Conceptual Frame Work: 12 Hrs

Concept need and process in entrepreneurship development. Role of enterprise in national and global economy. Types of enterprise – Merits and Demerits. Government policies and schemes for enterprise development. Institutional support in enterprise development and management

2. General principles of Business organization & administration, 12 Hrs

Styles of management, Decision making.

Entrepreneur: Entrepreneurial motivation & morale – dynamics of motivation. Entrepreneurial competency–Concepts. Developing Entrepreneurial competencies - requirements and understanding the process of entrepreneurship development, self-awareness, interpersonal skills, creativity, assertiveness, achievement, factors affecting entrepreneur role. Time management

3. Launching and Organising An Enterprise: 12 Hrs

Environment scanning – Information, sources, schemes of assistance, problems. Enterprise selection, market assessment, enterprise feasibility study, SWOT Analysis. Resource mobilisation - finance, technology, raw material, site and manpower. Costing and marketing management and quality control. Feedback, monitoring and evaluation.

General principles of HR & Financial management. Auditing and Budgetary control.

4. Growth Strategies and Networking: 12 Hrs

Performance appraisal and assessment. Profitability and control measures, demands and challenges. Need for diversification. Future Growth – Techniques of expansion and diversification, vision strategies. Concept and dynamics. Methods, Joint venture, co-ordination and feasibility study.

5. Preparing project proposal to start on new enterprise project work: 12 Hrs

Feasibility Report, Planning, Resource mobilization and implementation

Business Ethics

REFERENCES

1. Akhauri, M.M.P. (1990): Entrepreneurship for Women in India, NIESBUD, New Delhi.
2. Hisrich, R.D & Brush, C.G. (1996) The Women Entrepreneurs, D.C. Health& Co., Toranto.
3. Hisrich, R.D. and Peters, M.P. (1995): Entrepreneurship – Starting, Developing and Managing a New Enterprise, Richard D., Inwin, INC, USA.
4. Meredith, G.G. et al (1982): Practice of Entrepreneurship, ILO, Geneva.
5. Patel, V.C. (1987): Women Entrepreneurship – Developing NewEntrepreneurs, Ahmedabad EDII.

INDUSTRIAL PHARMACY PRACTICAL - II (MIP 205P)

1. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique.
3. Protein binding studies of a highly protein bound drug & poorly protein bound drug
4. Bioavailability studies of Paracetamol (Animal).
5. Pharmacokinetic and IVIVC data analysis by standard Pharmacokinetic software
6. In vitro cell studies for permeability and metabolism
7. Formulation and evaluation of tablets
8. Formulation and evaluation of capsules
9. Formulation and evaluation of injections
10. Formulation and evaluation of emulsion
11. Formulation and evaluation of suspension.
12. Formulation and evaluation of enteric coating tablets.
13. Preparation and evaluation of a freeze dried formulation.
14. Preparation and evaluation of a spray dried formulation.

SEMESTER – III

RESEARCH METHODOLOGY & BIOSTATISTICS (MRM 301T)

UNIT – I

General Research Methodology: Research, objective, requirements, practical difficulties, types of research, scientific methods of research, types of studies, study design.

Review of literature - Sources of information. Searching of library documents and databases online and offline (Pubmed, Biological abstracts, other databases in pharmaceutical sciences). Introduction to internet searching using advanced search tools.

UNIT – II

Collection and analysis of data: Types of data and data collection techniques, processing of data, coding, tabulation and analysis of data.

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests (Student's t-test, ANOVA, Correlation coefficient, regression), non-parametric tests (Wilcoxan rank tests, analysis of variance, correlation, Chi square test), null hypothesis, P values, degree of freedom, interpretation of P values, different software for statistical analysis.

UNIT – III

Medical Research: History, values in medical ethics, strategies to eliminate errors/bias, controls, randomisation, cross over design, placebo, blinding techniques autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, vendor relationships, treatment of family members.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, location of animal facilities to laboratories, anaesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Technical writing, thesis/research report writing, structure of thesis, editing and formatting, reference citations, abstracting, plagiarism and paraphrasing, tools for writing good research report.

UNIT – VI

Research reporting - poster presentation, seminar and conference presentation, publishing in journals, copyright.

REFERENCE BOOKS

1. Atiya Khanum Irfan Ali Khan, Biostatistics for Pharmacy, 2nd Edition, 2007, Ukaaz Publications, Hyderabad.
2. C. George Thomas. Research Methodology and Scientific Writing First edition, 2016, Ane Books Pvt. Ltd.; New Delhi.
3. C. R Kothari. Research Methodology: Methods and Techniques. New Age International (P)Ltd, Publishers. New Delhi.
4. Mahajan, B.K. Methods in Biostatistics for Medical Students and Research workers, 7th

Edition 2008 Jaypee Brothers.
5. Putul Mahanta , Medical Writing: A Guide for Medicos, Educators and Researchers Jaypee Brothers Medical Publishers; First edition (2018).
6. Ranjan Das, Biomedical Research Methodology: Including Biostatistical Applications. 1st Edn. Jaypee Brothers.
7. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 3rd Edition 2011, Sage Publications India Pvt. Ltd., New Delhi.
8. Sharma Suresh. Research Methodology and Biostatistics- A Comprehensive Guide for Health Care Professionals. 1st Edn. Elsevier India.
9. Sunder Rao. P.S.S and Richard. J. An introduction to Biostatistics: A manual for students in health sciences. Prentice-Hall of India Pvt. Ltd Publishers.

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MODEL QUESTION PAPER

QP CODE:…… **Reg No…….**

First Semester M. Pharm. Degree Examinations 2022

M. Pharm. (Industrial Pharmacy)

PAPER - I – MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MIP 101T)

- Answer all questions

Time: 3 hours Maximum: Marks: 75

Essays (3x10=30)

1. Explain the theory of fluorescence. What are the factors affecting fluorescence?

2. Classify chromatographic methods based on mechanism of separation and add a note on column chromatography.

3. What is the principle of NMR spectroscopy? What are its applications?

Short notes (9X5=45)

4. Compare flame emission and atomic absorption spectroscopy.

5. Discuss about gel electrophoresis.

6. What is Bragg's law? Describe rotating crystal technique in x-ray crystallography.

7. Write a note on ion selective electrodes.

8. Discuss about the principle and instrumentation of differential thermal analysis.

9. Briefly explain the principle and working of potentiometer.

10. Write about MALDI. Explain principle and applications of MALDI.

11. Sample handing techniques in IR spectroscopy.

12. Write briefly on derivative UV spectroscopy.

MODEL QUESTION PAPER

QP CODE:…… **Reg No…….**

First Semester M. Pharm. Degree Examinations 2022

M. Pharm. (Industrial Pharmacy)

Paper II – Pharmaceutical Formulation Development (MIP 102T)

Time: 3 Hours **Total Marks: 75**

Answer all questions.
Draw diagrams wherever necessary.

Essays **(3x10=30)**

1. What do you mean by Drug Excipient compatibility? Discuss in detail the methods employed for its determination.

2. Discuss the various techniques employed in optimisation of Pharmaceutical formulations.

3. What is drug stability? Explain the stability testing protocols of drugs and pharmaceuticals.

Short Notes **(9x5=45)**

4. Sink and Non sink models.

5. Shelf life assignment.

6. Response surface method.

7. Cosolvency.

8. IVIVC.

9. Hydrotropy.

10. Powder flow.

11. Dissolution test apparatus.

12. Crystal morphology.

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MODEL QUESTION PAPER

QP CODE:…… **Reg No…….**

First Semester M. Pharm. Degree Examinations 2022

M. Pharm. (Industrial Pharmacy)

Paper III – Novel Drug Delivery Systems (MIP 103T)

Time: 3 Hours **Total Marks: 75**

Answer all questions.
Draw diagrams wherever necessary.

Essays **(3x10=30)**

1. Explain the various carriers for Drug delivery.
2. Explain the Pharmacokinetic design for Drug Delivery Systems.
3. Explain the formulation and evaluation of Targeted Drug delivery systems.

Short Notes **(9x5=45)**

4. Activation modulated DDS.
5. Mucoadhesive DDS.
6. Ocular Delivery systems.
7. Colon specific drug delivery.
8. Evaluation of Skin delivery systems.
9. Formulation and evaluation of shampoos.
10. Peptide drug delivery techniques.
11. rDNA technology.
12. Bioelectronic medicines.

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MODEL QUESTION PAPER

QP CODE:…… **Reg No…….**

First Semester M. Pharm. Degree Examinations 2022

M. Pharm. (Industrial Pharmacy)

Paper IV – Intellectual Property Rights & Regulatory Affairs (MIP 104T)

Time: 3 Hours **Total Marks: 75**

Answer all questions.
Draw diagrams wherever necessary.

Essays **(3x10=30)**

1. Explain Site Master File and Drug Master File.

2. Explain the functioning of Drug Regulatory Authorities in India.

3. Explain the protocols for Clinical trial documentation.

Short Notes **(9x5=45)**

4. Role of GATT

5. Batch Manufacturing Record.

6. Types of Patents.

7. NDA & ANDA.

8. Trademark protection.

9. Regulatory requirements for contract research organisations.

10. Regulations for biosimilars.

11. ICH guidelines.

12. Generic drug products.

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MODEL QUESTION PAPER

QP CODE:…… **Reg No…….**

Second Semester M. Pharm. Degree Examinations 2022

M. Pharm. (Industrial Pharmacy)

Paper I – Advanced Biopharmaceutics & Pharmacokinetics (MIP 201T)

Time: 3 Hours **Total Marks: 75**

Answer all questions.
Draw diagrams wherever necessary.

Essays **(3x10=30)**

1. Explain the mechanisms and factors affecting Drug absorption.

2. Explain one compartment model for extra vascular administration with various pharmacokinetic parameters.

3. Explain Bioequivalence and various bioequivalence study designs.

Short Notes **(9x5=45)**

4. BCS.

5. Biopharmaceutical considerations of tablets as a dosage form.

6. Drug Product Performance.

7. Drug product stability considerations.

8. Bio similar drug products.

9. Pharmacokinetics of Proteins & peptides.

10. pH partition theory in absorption.

11. IV infusion and loading dose.

12. Different theories of dissolution process.

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MODEL QUESTION PAPER

QP CODE:…… **Reg No…….**

Second Semester M. Pharm. Degree Examinations 2022

M. Pharm. (Industrial Pharmacy)

Paper II – Scale Up and Technology Transfer (MIP 202T)

Time: 3 Hours **Total Marks: 75**

Answer all questions.
Draw diagrams wherever necessary.

Essays **(3x10=30)**

1. Explain the basic requirements of Scale up of tablet manufacture.

2. Explain the general concepts and protocols for equipment validation.

3. What is process validation. Explain the process validation protocols for tablet compression and coating.

Short Notes **(9x5=45)**

4. Scale up of semisolid dosage forms.

5. Problems encountered during Transfer of Technology.

6. Industrial effluent testing.

7. Mechanical hazards and its prevention.

8. Validation of Water process systems.

9. Vendor qualification.

10. Cleaning validation.

11. Concept of safety management

12. Solid waste management.

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MODEL QUESTION PAPER

QP CODE:…… **Reg No…….**

Second Semester M. Pharm. Degree Examinations 2022

M. Pharm. (Industrial Pharmacy)

Paper III – Pharmaceutical Production Technology (MIP 203T)

Time: 3 Hours **Total Marks: 75**

Answer all questions.
Draw diagrams wherever necessary.

Essays **(3x10=30)**

1. Explain the design and layout for the production of tablets.

2. Explain the salient features in the production of parenteral preparations.

3. Explain the application and validation of HVAC systems in a manufacturing unit.

Short Notes **(9x5=45)**

4. Spheronisers and marumerisers.

5. Fluidised bed coating technology.

6. Production planning and control

7. Concept of TQM.

8. Orange Book

9. Freeze drying

10. Packaging of parenterals.

11. Production and storage of water for injection.

12. Hard gelatin capsule filling.

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MODEL QUESTION PAPER

QP CODE:…… **Reg No…….**

Second Semester M. Pharm. Degree Examinations 2022

M. Pharm. (Industrial Pharmacy)

Paper IV – Entrepreneurship Management (MIP 204T)

Time: 3 Hours **Total Marks: 75**

Answer all questions.
Draw diagrams wherever necessary.

Essays **(3x10=30)**

1. Explain the important steps in launching a pharmaceutical enterprise.

2. Explain the general principles of Financial management.

3. Explain the competencies required for an entrepreneur.

Short Notes **(9x5=45)**

4. Government policies for enterprise development.

5. Styles of management.

6. Motivation & Morale.

7. Time management.

8. SWOT analysis.

9. Resource mobilisation of raw materials.

10. Expansion and diversification.

11. Business ethics.

12. Marketing management.

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KERALA UNIVERSITY OF HEALTH SCIENCES

Thrissur - 680596

SYLLABUS

POST GRADUATE COURSE IN PHARMACY

Master of Pharmacy (M. Pharm.)

PHARMACEUTICAL QUALITY ASSURANCE	**MQA**
KUHS Course Code	**530**

(2022-23 Academic year onwards)

2022

Course of study for M.Pharm. I & II Semester

MQA	Pharmaceutical Quality Assurance				
Course Code	**Course**	**Credit Hours**	**Credit Points**	**Hrs./wk**	**Marks**
Semester I					
MQA 101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MQA 102T	Quality Management Systems	4	4	4	100
MQA 103T	Quality Control and Quality Assurance	4	4	4	100
MQA 104T	Product Development and Technology Transfer	4	4	4	100
MQA 105P	Quality Assurance Practical - I	12	6	12	150
-	Seminar/Assignment	7	4	7	100
Total		**35**	**26**	**35**	**650**
Semester II					
MQA 201T	Hazards and Safety Management	4	4	4	100
MQA 202T	Pharmaceutical Validation	4	4	4	100
MQA 203T	Audits and Regulatory Compliance	4	4	4	100
MQA 204T	Pharmaceutical Manufacturing Technology	4	4	4	100
MQA 205P	Quality Assurance Practical – II	12	6	12	150
-	Seminar /Assignment	7	4	7	100
Total		**35**	**26**	**35**	**650**

Course of study for M. Pharm. III & IV Semester

Course Code	**Course**	**Credit Hours**	**Credit Points**	**Marks**
Semester III				
MRM 301T	Research Methodology and Biostatistics	4	4	100
-	Journal Club	1	1	25
-	Discussion / Presentation (proposal presentation)	2	2	25
-	Research Work	28	14	350
Total		**35**	**21**	**500**
Semester IV				
-	Journal Club	1	1	25
-	Pre submission Discussion / Presentation	3	3	75
-	Research Work	31	16	400
Total		**35**	**20**	**500**

PHARMACEUTICAL QUALITY ASSURANCE (MQA)

SEMESTER – I

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPT 101T)

SCOPE:

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

OBJECTIVES:

Upon completion of the course, student shall be able to know about

- Chemicals and excipients
- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills for handling of the instruments

THEORY **60 Hrs**

8. a. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation 10 Hrs associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy.

b. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation.

c. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

d. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

9. NMR spectroscopy: Principle, Instrumentation, 10 Hrs Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR, Applications of NMR spectroscopy.

10. Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, 9 Hrs Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.

11. Chromatography: Principle, apparatus, instrumentation, chromatographic 9 Hrs parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following:

a) Thin Layer chromatography
b) High Performance Thin Layer Chromatography
c) Ion exchange chromatography
d) Column chromatography
e) Gas chromatography
f) High Performance Liquid chromatography
g) Ultra High Performance Liquid chromatography

h) Affinity chromatography
i) Gel Chromatography

12. a.Electrophoresis: Principle, Instrumentation, Workingconditions, factors affecting separation and applications of the following: 9 Hrs

1) Paper electrophoresis 2) Gel electrophoresis 3) Capillary electrophoresis 4) Zone electrophoresis 5) Moving boundary electrophoresis 6) Iso electric focusing

b.X ray Crystallography: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.

13. a. Potentiometry: Principle, working, Ion selective Electrodes and Application of potentiometry. 9 Hrs

b. Thermal Techniques: i) Differential scanning calorimetry (DSC): Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications.

2) Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). iii)Thermo Gravimetric Analysis (TGA): Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.

13. Immunological assays: RIA (Radio immuno assay), ELISA, Bioluminescence assays. 4 Hrs

REFERENCES

10. Spectrometric Identification of Organic compounds - Robert M Silverstein, 6th Edition, JohnWiley & Sons, 2004.
11. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman,5th Edition, Eastern Press, Bangalore, 1998.
12. Instrumental Methods of Analysis - Willards, 7th Edition, CBS publishers.
13. Practical Pharmaceutical Chemistry - Beckett and Stenlake, Vol II, 4th Edition, CBS Publishers, New Delhi, 1997.
14. Organic Spectroscopy - William Kemp, 3rd Edition, ELBS, 1991.
15. Quantitative Analysis of Drugs in Pharmaceutical formulation - P.D. Sethi, 3rd Edition, CBSPublishers, New Delhi, 1997.
16. Pharmaceutical Analysis-Modern Methods-Part B-J.W. Munson, Vol 11, Marcel Dekker Series.
17. Spectroscopy of Organic Compounds, 2nd Edition, P.S. Kalsi, Wiley Eastern Ltd, Delhi.
18. Textbook of Pharmaceutical Analysis, K.A. Connors, 3rd Edition, John Wiley & Sons, 1982.

QUALITY MANAGEMENT SYSTEMS
(MQA 102T)

Scope:

This course is designed to impart fundamental knowledge and concepts about various quality management principles and systems utilized in the manufacturing industry. It also aids in understanding the quality evaluation in the pharmaceutical industries.

Objectives:

At completion of this course it is expected that students will be able to understand-

- · The importance of quality
- · ISO management systems
- · Tools for quality improvement
- · Analysis of issues in quality
- · Quality evaluation of pharmaceuticals
- · Stability testing of drug and drug substances
- · Statistical approaches for quality

THEORY **60 Hrs**

1. Introduction to Quality: 12 Hrs

Evolution of Quality, Definition of Quality, Dimensions of Quality.
Quality as a Strategic Decision: Meaning of strategy and strategic quality management, mission and vision statements, quality policy, Quality objectives, strategic planning and implementation, McKinsey 7s model, Competitive analysis, Management commitment to quality.
Customer Focus: Meaning of customer and customer focus, Classification of customers, Customer perception of quality, Factors affecting customer perception, Customer requirements, Meeting customer needs and expectations, Customer satisfaction and Customer delight, Handling customer complaints, Cost of Quality: Cost of quality, Categories of cost of Quality, Models of cost of quality, Optimising costs, Preventing cost of quality.

2. Pharmaceutical quality Management: 12 Hrs

Basics of Quality Management, Total Quality Management (TQM), Principles of Six sigma, ISO 9001:2008, 9001:2015, ISO 14001:2004, Pharmaceutical Quality Management – ICH Q10, Knowledge management, Quality Metrics, Operational Excellence and Quality Management Review. OSHAS guidelines, WHO Certification Scheme, NABL certification and accreditation.

3. Six System Inspection model: 12 Hrs

Quality Management system, Production system, Facility and Equipment system, Laboratory control system, Materials system, Packaging and labeling system.
Quality systems: Change Management/ Change control. Deviations, Out of Specifications (OOS), Out of Trend (OOT), Complaints - evaluation and handling, Investigation and determination of root cause, Corrective & Preventive Actions (CAPA), Returns and Recalls, Vendor Qualification, Annual Product Reviews, Batch Review and Batch Release.

4. Drug Stability: 12 Hrs

ICH guidelines for stability testing of drug substances and drug products.
Study of ICH Q8, Quality by Design and Process development report, Accelerated Stability Study,
Quality risk management: Introduction, risk assessment, risk control, risk review, risk management tools, HACCP, risk ranking and filtering according to ICH Q9 guidelines

5. Statistical Process control (SPC): 8 Hrs

Definition and Importance of SPC, Quality measurement in manufacturing, Statistical control charts - concepts and general aspects, Advantages of statistical control, Process capability, Estimating Inherent or potential capability from a control chart analysis, Measuring process control and quality improvement, Pursuit of decreased process variability.

6. Regulatory Compliance through Quality Management and development of Quality Culture. 4 Hrs

Benchmarking: Definition of benchmarking, Reasons for benchmarking, Types of Benchmarking, Benchmarking process, Advantages of benchmarking, Limitations of benchmarking.

REFERENCES

1. Al Endres. Implementing Juran's Road Map for Quality Leadership: Benchmarks and Results, Wiley, 2000.
2. Jiju Antony, David Preece. Understanding, Managing and Implementing Quality: Frameworks, Techniques and Cases, Routledge, 2002.
3. Edward E. Lawler; Susan Albers Mohrman; George Benson, Jossey-Bass. Organizing for High Performance: Employee Involvement, TQM, Reengineering and Knowledge Management in the Fortune 1000: The CEO Report 2001.
4. James W. Fairfield Sonn. Corporate Culture and the Quality Organization Quorum Books, 2001.
5. Christine Avery; Diane Zabel. The Quality Management Sourcebook: An International Guide to Materials and Resources, Routledge, 1997.
6. Nancy R. Tague. The Quality Toolbox, Second Edition, ASQ Publications.
7. Joseph M. Juran and Joseph A. De Feo. Juran's Quality Handbook, Sixth Edition, ASQ Publications.
8. Duke Okes. Root Cause Analysis, The Core of Problem Solving and Corrective Action, 2009, ASQ Publications.

QUALITY CONTROL AND QUALITY ASSURANCE
(MQA 103T)

Scope:

This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It covers the important aspects like cGMP, QC tests, documentation, quality certifications, GLP and regulatory affairs.

Objectives:

At completion of this course it is expected that the student shall be able to know

- · The cGMP aspects in a pharmaceutical industry
- · To appreciate the importance of documentation
- · To understand the scope of quality certifications applicable to Pharmaceutical industries
- · To understand the responsibilities of QA & QC departments.

THEORY **60 Hrs**

1. Introduction: **12 Hrs**

Concept and Evolution of Quality Control and Quality Assurance, Good Laboratory Practice, GMP, Overview of ICH Guidelines - QSEM, with special emphasis on Q series guidelines.

Good Laboratory Practices: Scope of GLP, Definitions, Quality assurance unit, protocol for conduct of non-clinical testing, control on animal house, report preparation and documentation.

2. cGMP guidelines according to schedule M, USFDA (inclusive of CDER and CBER) Pharmaceutical Inspection Convention(PIC), WHO and EMEA covering: **12 Hrs**

Organization and personnel responsibilities, training, hygiene and personal records, drug industry location, design, construction and plant lay out, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination and Good Warehousing Practice. CPCSEA guidelines.

3. Analysis of raw materials, finished products, packaging materials, **12 Hrs**

in process quality control (IPQC), Developing specification (ICH Q6 and Q3). Purchase specifications and maintenance of stores for raw materials. In process quality control and finished products quality control for following dosage forms in Pharma industry according to Indian, US and British pharmacopoeias: tablets, capsules, ointments, suppositories, creams, parenterals, ophthalmic and surgical products (How to refer pharmacopoeias). Quality control test for containers, closures and secondary packing materials.

4. Documentation in pharmaceutical industry: **12 Hrs**

Three tier documentation, Policy, Procedures and Work instructions, and records (Formats), Basic principles- How to maintain, retention and retrieval etc. Standard operating procedures (How to write), Master Batch Record, Batch Manufacturing Record, Quality audit plan and reports. Specification and test procedures, Protocols and reports. Distribution records. Electronic data handling. Submission documents for regulators DMFs, as Common Technical Document and Electronic Common Technical Documentation (CTD, eCTD).

5. Manufacturing operations and controls: 12 Hrs

Sanitation of manufacturing premises, mix-ups and cross contamination, processing of intermediates and bulk products, packaging operations, release of finished product, process deviations, charge-in of components, time limitations on production, drug product inspection, expiry date calculation, calculation of yields, production record review, change control, sterile products, aseptic process control, packaging,

Introduction, scope and importance of intellectual property rights. Concept of trade mark, copyright and patents.

REFERENCES

1. Quality Assurance Guide by organization of Pharmaceutical Procedures of India, 3rd revised edition, Volume I & II, Mumbai, 1996.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69, Marcel Dekker Series, 1995.
3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I & II, 2nd edition, WHO Publications, 1999.
4. How to Practice GMP's – PP Sharma, Vandana Publications, Agra, 1991.
5. The International Pharmacopoeia – Vol I, II, III, IV & V - General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excepients and Dosage forms 3rd edition, WHO, Geneva, 2005.
6. Good laboratory Practice Regulations – Allen F. Hirsch, Volume 38, Marcel Dekker Series, 1989.
7. ICH guidelines
8. ISO 9000 and total quality management
9. The drugs and cosmetics act 1940 – Deshpande, Nilesh Gandhi, 4th edition, Susmit Publishers, 2006.
10. QA Manual – D.H. Shah, 1st edition, Business Horizons, 2000.
11. Good Manufacturing Practices for Pharmaceuticals a plan for total quality control – Sidney H. Willig, Vol. 52, 3rd edition, Marcel Dekker Series.
12. Steinborn L. GMP/ISO Quality Audit Manual for Healthcare Manufacturers and Their Suppliers, Sixth Edition, (Volume 1 - With Checklists and Software Package). Taylor & Francis; 2003.
13. Sarker DK. Quality Systems and Controls for Pharmaceuticals. John Wiley & Sons; 2008.
14. Dean DA, Evans ER and Hall IH. Pharmaceutical Packaging Technology. London, Taylor & Francis, UK, 2005.
15. Quality control of packaging materials in the pharmaceutical industry by Kenneth Harburn Vol 4, Taylor and Francis, 2019.
16. Schedule M and Schedule N.

PRODUCT DEVELOPMENT AND TECHNOLOGY TRANSFER
(MQA 104T)

Scope

This deal with technology transfer covers the activities associated with Drug Substance, Drug Product and analytical tests and methods, required following candidate drug selection to completion of technology transfer from R&D to the first receiving site and technology transfer related to post-marketing changes in manufacturing places.

Objectives

Upon completion of this course the student should be able to

· To understand the new product development process

· To understand the necessary information to transfer technology from R&D to actual manufacturing by sorting out various information obtained during R&D

· To elucidate necessary information to transfer technology of existing products between various manufacturing places

THEORY **60 Hrs**

1. **Principles of Drug discovery and development:** **12 Hrs**

Introduction, Stages of clinical research process. Development and informational content for Investigational New Drugs Application (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA), Supplemental New Drug Application (SNDA), Scale Up Post Approval Changes (SUPAC) and Bulk active chemical Post approval changes (BACPAC), Post marketing surveillance, Product registration guidelines – CDSCO, USFDA.

2. Pre-formulation studies: **12 Hrs**

Introduction/concept, organoleptic properties, purity, impurity profiles, particle size, shape and surface area. Solubility, Methods to improve solubility of Drugs: Surfactants & its importance, co-solvency. Techniques for the study of Crystal properties and polymorphism. Pre-formulation protocol, Stability testing during product development.

3. **Pilot plant scale up:** 12 Hrs

Concept, Significance, design, layout of pilot plant scale up study, operations, large scale manufacturing techniques (formula, equipment, process, stability and quality control) of solids, liquids, semisolid and parenteral dosage forms. New era of drug products: opportunities and challenges.

4. **Pharmaceutical packaging:** 12 hrs

Pharmaceutical dosage form and their packaging requirements, Pharmaceutical packaging materials, Medical device packaging, Enteral Packaging, Aseptic packaging systems, Container closure systems, Issues facing modern drug packaging, Selection and evaluation of Pharmaceutical packaging materials.
Quality control test: Containers, closures and secondary packing materials.

5. **Technology transfer:** 12 hrs

Development of technology by R & D, Technology transfer from R & D to production, Optimization and Production, Qualitative and quantitative technology models.
Documentation in technology transfer: Development report, technology transfer plan and Exhibit.

REFERENCES

1. Charles G. Smith, James T and O. Donnell. The process of new drug discovery and development. I and IIEdition (2006) CRC Press, Group of Taylor and Francis.

2. Leon Lac Lachman, Herbert A. Liberman, Theory and Practice of Industrial Pharmacy. Marcel Dekker Inc. New York.
3. Sidney H Willing, Murray M, Tuckerman. Williams Hitchings IV, Good manufacturing of pharmaceuticals (A Plan for total quality control) 3rd Edition. Bhalani publishing house Mumbai.
4. Leon Lachman, Herbert A. Liberman, Joseph B. Schwartz. Tablets Vol. I, II, III 2nd Edn. (1989) Marcel Dekker Inc. New York.
5. Milo Gibaldi, Text book of Bio- Pharmaceutics and clinical Pharmacokinetics.3rd Edn, Lea & Febriger, Philadelphia.
6. Vandana V. Patrevale. John I. Disouza. Maharukh T. Rustomji. Pharmaceutical product development. CRC Press, Group of Taylor and Francis.
7. Abdou H.M, Dissolution, Bioavailability and Bio-Equivalence. Mack Publishing Company, Eastern Pennsylvania.
8. Alfonso & Gennaro, Remingtons Pharmaceutical Sciences, 19th Edn.(1995)OO2C Lippincott; Williams and Wilkins A Wolters Kluwer Company, Philadelphia.
9. D.A. Sawant, The Pharmaceutical Sciences; the Pharma Path way 'Pure and applied Pharmacy' Pragathi Books Pvt. Ltd.
10. D.A. Dean. E.R. Evans, I.H. Hall. Pharmaceutical Packaging technology 1st Edition (Reprint 2006). Taylor and Francis. London and New York.

QUALITY ASSURANCE PRACTICAL - I
(MQA 105P)

PRACTICALS

1. Analysis of Pharmacopoeial compounds in bulk and in their formulations (tablet/ capsules/ semisolids) by UV Vis spectrophotometer
2. Simultaneous estimation of multi-drug component containing formulations by UV spectrophotometry
3. Experiments based on HPLC
4. Experiments based on Gas Chromatography
5. Estimation of riboflavin/quinine sulphate by fluorimetry
6. Estimation of sodium/potassium by flame photometry or AAS
7. Case studies on
   - · Total Quality Management
   - · Six Sigma
   - · Change Management/ Change control. Deviations,
   - · Out of Specifications (OOS)
   - · Out of Trend (OOT)
   - · Corrective & Preventive Actions (CAPA)
   - · Deviations
8. Development of Stability study protocol
9. Estimation of process capability
10. In process and finished product quality control tests for tablets, capsules, parenterals and semisolid dosage forms.
11. Assay of raw materials as per official monographs
12. Testing of related and foreign substances in drugs and raw materials
13. To carry out pre formulation study for tablets, parenterals (2 experiments).
14. To study the effect of pH on the solubility of drugs, (1 experiment)
15. Quality control tests for Primary and secondary packaging materials
16. Accelerated stability studies (1 experiment)
17. Improved solubility of drugs using surfactant systems (1 experiment)
18. Improved solubility of drugs using co-solvency method (1 experiment)
19. Determination of pKa and Log p of drugs.

SEMESTER – II
HAZARDS AND SAFETY MANAGEMENT
(MQA 201T)

Scope:

This course is designed to convey the knowledge necessary to understand issues related to different kinds of hazard and their management. Basic theoretical and practical discussions integrate the proficiency to handle the emergency situation in the pharmaceutical product development process and provides the principle based approach to solve the complex tribulations.

Objectives:

At completion of this course it is expected that students will be able to

· Understand about environmental problems among learners.

· Impart basic knowledge about the environment and its allied problems.

· Develop an attitude of concern for the industry environment.

· Ensure safety standards in pharmaceutical industry

· Provide comprehensive knowledge on the safety management

· Empower any ideas to clear mechanism and management in different kinds of hazard management system

· Teach the method of Hazard assessment, procedure, methodology for provide safe industrial atmosphere.

THEORY **60 Hrs**

1. Multidisciplinary nature of environmental studies: **12 Hrs**

Natural Resources, Renewable and non-renewable resources and associated problems,

a) Forest resources; b) Water resources; c) Mineral resources; d) Energy resources; e) Land resources

Ecosystems: Concept of an ecosystem and Structure and function of an ecosystem. Environmental hazards: Hazards based on Air, Water, Soil and Radioisotopes.

2. Air based hazards: 12 Hrs

Sources, Types of Hazards, Air circulation maintenance industry for sterile area and non-sterile area, Preliminary Hazard Analysis (PHA) Fire protection system: Fire prevention, types of fire extinguishers and critical Hazard management system.

3. Chemical based hazards: 12 Hrs

Sources of chemical hazards, Hazards of Organic synthesis, sulphonating hazard, Organic solvent hazard, Control measures for chemical hazards, Management of combustible gases, Toxic gases and Oxygen displacing gases management, Regulations for chemical hazard, Management of over-Exposure to chemicals and TLV concept.

4. Fire and Explosion: 12 hrs

Introduction, Industrial processes and Safety and hazards regulations, Fire protection system: Fire prevention, types of fire extinguishers and critical Hazard management system mechanical and chemical explosion, multiphase reactions, transport effects and global rates. Preventive and protective management from fires and explosion electricity passivation, ventilation, and sprinkling, proofing, relief systems -relief valves, flares, scrubbers.

5. Hazard and risk management: 12 Hrs

Self-protective measures against workplace hazards. Critical training for risk management, Process of hazard management, ICH guidelines on risk assessment and Risk management methods and Tools.

Factory act and rules, fundamentals of accident prevention, elements of safety programme and safety management, Physicochemical measurements of effluents, BOD, COD, Determination of some contaminants, Effluent treatment procedure.

REFERENCES

1. Y.K. Sing, Environmental Science, New Age International Pvt.. Publishers, Bangalore.
2. "Quantitative Risk Assessment in Chemical Process Industries" American Institute ofChemical Industries, Centre for Chemical Process safety.
3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India.
4. Hazardous Chemicals: Safety Management and Global Regulations, T.S.S. Dikshith, CRC press.

PHARMACEUTICAL VALIDATION
(MQA 202T)

Scope:

The main purpose of the subject is to understand about validation and how it can be applied to industry and thus improve the quality of the products. The subject covers the complete information about validation, types, methodology and application.

Objectives:

At completion of this course, it is expected that students will be able to understand

- · The concepts of calibration, qualification and validation
- · The qualification of various equipments and instruments
- · Process validation of different dosage forms
- · Validation of analytical method for estimation of drugs
- · Cleaning validation of equipments employed in the manufacture of pharmaceuticals

THEORY **60 Hrs**

1. Introduction to validation: 10 Hrs

Definition of Calibration, Qualification and Validation, Scope, frequency and importance. Difference between calibration and validation. Calibration of weights and measures. Advantages of Validation, scope of Validation, Organization for Validation, Validation Master plan, Types of Validation, Streamlining of qualification & Validation process.

Qualification: User requirement specification, Design qualification, Factory Acceptance Test (FAT)/Site Acceptance Test (SAT), Installation qualification, Operational qualification, Performance qualification, Re-Qualification (Maintaining status- Calibration Preventive Maintenance, Change management).

2.Qualification of manufacturing equipment: 10 Hrs

Dry Powder Mixers, Fluid Bed and Tray dryers, Tablet Compression (Machine), Dry heat sterilization/Tunnels, Autoclaves, Membrane filtration, Capsule filling machine.

Qualification of analytical instruments: UV-Visible spectrophotometer, FTIR, DSC, GC, HPLC, HPTLC, LC-MS.

3.Qualification of laboratory equipments: 10 Hrs

Hardness tester, Friability test apparatus, tap density tester, Disintegration tester, Dissolution test apparatus

Validation of Utility systems: Pharmaceutical water system & pure steam, HVAC system, Compressed air and nitrogen.

4.Process Validation: **10 Hrs**

Concept, Process and documentation of Process Validation. Prospective, Concurrent & Retrospective Validation, Re-validation criteria, Process Validation of various formulations (Coated tablets, Capsules, Ointment/Creams, Liquid Orals and aerosols.), Aseptic filling: Media fill validation, USFDA guidelines on Process Validation- A life cycle approach.

Analytical method validation: General principles, Validation of analytical method as per ICH guidelines and USP.

5. Cleaning Validation: 10 Hrs

Cleaning Method development, Validation of analytical method used in cleaning, Cleaning of Equipment, Cleaning of Facilities. Cleaning in place (CIP). Validation of facilities in sterile and non-sterile plant.

Computerized system validation: Electronic records and digital signature-21 CFR Part 11 and GAMP

6. General Principles of Intellectual Property: 10 Hrs

Concepts of Intellectual Property (IP), Intellectual Property Protection (IPP), Intellectual Property Rights (IPR); Economic importance, mechanism for protection of Intellectual Property–Patents, Copyright, Trademark; Factors affecting choice of IP protection; Penalties for violation; Role of IP in pharmaceutical industry; Global ramification and financial implications. Filing a patent application; patent application forms and guidelines. Types patent applications-provisional and non-provisional, PCT and convention patent applications; International patenting requirement procedures and costs; Rights and responsibilities of a patentee; Practical aspects regarding maintaining of a Patent file; Patent infringement meaning and scope. Significance of transfer technology (TOT), IP and ethics-positive and negative aspects of IPP; Societal responsibility, avoiding unethical practices.

REFERENCES

1. B. T. Loftus & R. A. Nash, "Pharmaceutical Process Validation", Drugs and Pharm Sci. Series, Vol. 129, 3rd Ed., Marcel Dekker Inc., N.Y.
2. The Theory & Practice of Industrial Pharmacy, 3rd edition, Leon Lachman, Herbert A. Lieberman, Joseph. L. Karig, Varghese Publishing House, Bombay.
3. Validation Master plan by Terveeks or Deeks, Davis Harwood International publishing.
4. Validation of Aseptic Pharmaceutical Processes, 2nd Edition, by Carleton & Agalloco, (Marcel Dekker).
6. Michael Levin, Pharmaceutical Process Scale-Up", Drugs and Pharm. Sci. Series, Vol. 157,2nd Ed., Marcel Dekker Inc., N.Y.
7. Validation Standard Operating Procedures: A Step by Step Guide for Achieving Compliance in the Pharmaceutical, Medical Device, and Biotech Industries, Syed Imtiaz Haider
8. Pharmaceutical Equipment Validation: The Ultimate Qualification Handbook, Phillip A. Cloud, Interpharm Press.
9. Validation of Pharmaceutical Processes: Sterile Products, Frederick J. Carlton (Ed.) and James Agalloco (Ed.), Marcel Dekker.
10. Analytical Method validation and Instrument Performance Verification by Churg Chan, Heiman Lam, Y.C. Lee, Yue. Zhang, Wiley Interscience.
11. Huber L. Validation and Qualification in Analytical Laboratories. Informa Healthcare
12. Wingate G. Validating Corporate Computer Systems: Good IT Practice for Pharmaceutical Manufacturers. Interpharm Press.
13. LeBlanc DA. Validated Cleaning Technologies for Pharmaceutical Manufacturing. Interpharm Press.

AUDITS AND REGULATORY COMPLIANCE
(MPA 203T)

Scope:

This course deals with the understanding and process for auditing in pharmaceutical industries. This subject covers the methodology involved in the auditing process of different in pharmaceutical industries.

Objectives:

Upon completion of this course the student should be able to:

- To understand the importance of auditing
- To understand the methodology of auditing
- To carry out the audit process
- To prepare the auditing report
- To prepare the check list for auditing

THEORY **60 Hrs**

1. Introduction: 12 Hrs

Objectives, Management of audit, types of audit, responsibilities, Planning process, information gathering, administration, Classifications of deficiencies.

2. Role of quality systems and audits in pharmaceutical manufacturing environment: 12 Hrs

cGMP Regulations, Quality assurance functions, Quality systems approach, Management responsibilities, Resource, Manufacturing operations, Evaluation activities, Transitioning to quality system approach, Audit checklist for drug industries.

3. Auditing of vendors and production department: 12 Hrs

Bulk Pharmaceutical Chemicals and packaging material Vendor audit, Warehouse and weighing, Dry Production: Granulation, tableting, coating, capsules, sterile production and packaging.

4. Auditing of Microbiological laboratory: 12 Hrs

Auditing the manufacturing process, Product and process information, General areas of interest in the building raw materials, Water, Packaging materials.

5. Auditing of Quality Assurance and engineering department: 12 Hrs

Quality Assurance Maintenance, Critical systems: HVAC, Water, Water for Injection systems.

REFERENCES

1. Karen Ginsbury and Gil Bismuth, Compliance auditing for Pharmaceutical Manufacturers. Interpharm/CRC, Boca Raton, London New York, Washington D.C.
2. Shayne Cox Gad. Pharmaceutical Manufacturing Handbook, Regulations and Quality Wiley-Interscience, A John Wiley and sons, Inc., Publications.
3. Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyar. Handbook of microbiological Quality control. CRC Press. 2000.
4. Donald C. Singer, Raluca-loana Stefan, Jacobus F. Van Staden. Laboratory auditing for quality and regulatory compliance. Taylor and Francis (2005).

PHARMACEUTICAL MANUFACTURING TECHNOLOGY
(MQA 204T)

Scope:

This course is designed to impart knowledge and skills necessary to train the students with the industrial activities during Pharmaceutical Manufacturing.

Objectives:

At completion of this course it is expected that students will be able to understand:

· The common practice in the pharmaceutical industry developments, plant layout and production planning.
· Will be familiar with the principles and practices of aseptic process technology, non-sterile manufacturing technology and packaging technology.
· Have a better understanding of principles and implementation of Quality by design (QbD) and process analytical technology (PAT) in pharmaceutical manufacturing.

THEORY **60 Hrs**

1. Pharmaceutical industry developments: 12 Hrs

Legal requirements and Licenses for API and formulation industry, Plant location Factors influencing.
Plant layout: Factors influencing, Special provisions, Storage space requirements, sterile and aseptic area layout.
Production planning: General principles, production systems, calculation of standard cost, process planning, routing, loading, scheduling, dispatching of records, production control.

2. Aseptic process technology: 12 Hrs

Manufacturing, manufacturing flowcharts, in process-quality control tests for following sterile dosage forms: Ointment, Suspension and Emulsion, Dry powder, Solution (Small Volume & large Volume).
Advanced sterile product manufacturing technology: Area planning & environmental control, wall and floor treatment, fixtures and machineries, change rooms, personnel flow, utilities & utilities equipment location, engineering and maintenance.
Process Automation in Pharmaceutical Industry: With specific reference to manufacturing of sterile semisolids, Small Volume Parenterals & Large Volume Parenterals (SVP & LVP), Monitoring of Parenteral manufacturing facility, Cleaning in Place (CIP), Sterilization in Place (SIP), Prefilled Syringe, Powdered Jet, Needle Free Injections, and Form Fill Seal Technology (FFS). Lyophilization technology: Principles, process, equipment.

3. Non sterile manufacturing process technology: 12 Hrs

Manufacturing, manufacturing flowcharts, in process-quality control tests for following Non-Sterile solid dosage forms: Tablets (compressed & coated), Capsules (Hard & Soft).

Advance non-sterile solid product manufacturing technology: Process Automation in Pharmaceutical Industry with specific reference to manufacturing of tablets and coated products, Improved Tablet Production: Tablet production process, granulation and pelletization equipments, continuous and batch mixing, rapid mixing granulators, rota granulators, spheronizers and marumerisers, and other specialized granulation and drying equipments. Problems encountered.

Coating technology: Process, equipments, particle coating, fluidized bed coating, application techniques. Problems encountered.

4. Containers and closures for pharmaceuticals: 12 Hrs

Types, performance, assuring quality of glass; types of plastics used, Drug plastic interactions, biological tests,

modification of plastics by drugs; different types of closures and closure liners; film wrapper; blister packs; bubble packs; shrink packaging; foil / plastic pouches, bottle seals, tape seals, breakable seals and sealed tubes; quality control of packaging material and filling equipment, flexible packaging, product package compatibility, transit worthiness of package, Stability aspects of packaging. Evaluation of stability of packaging material.

5. Quality by design (QbD) and process analytical technology(PAT): 12 Hrs

Current approach and its limitations. Why QbD is required, Advantages, Elements of QbD, Terminology: QTPP. CMA, CQA, CPP, RLD, Design space, Design of Experiments, Risk Assessment and mitigation/minimization. Quality by Design, Formulations by Design, QbD for drug products, QbD for Drug Substances, QbD for Excipients, Analytical QbD. FDA initiative on process analytical technology. PAT as a driver for improving quality and reducing costs: quality by design (QbD), QA, QC and GAMP. PAT guidance, standards and regulatory requirements.

REFERENCES

1. Lachman L, Lieberman HA, Kanig JL. The theory and practice of industrial pharmacy, 3rd ed., Varghese Publishers, Mumbai 1991.
2. Sinko PJ. Martin's physical pharmacy and pharmaceutical sciences, 5 ed., B.I. Publications Pvt. Ltd, Noida, 2006.
3. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms: tablets Vol. I-III, 2nd ed., CBS Publishers & distributors, New Delhi, 2005.
4. Banker GS, Rhodes CT. Modern Pharmaceutics, 4th ed., Marcel Dekker Inc, New York, 2005.
5. Sidney H Willing, Murray M, Tuckerman. Williams Hitchings IV, Good manufacturing of pharmaceuticals (A Plan for total quality control) 3rd Edition. Bhalani Publishing House, Mumbai.
6. Indian Pharmacopoeia, Controller of Publication, Delhi, 1996.
7. British Pharmacopoeia. British Pharmacopoeia Commission Office, London, 2008.
8. United States Pharmacopoeia. United States Pharmacopeial Convention, Inc, USA, 2003.
9. Dean DA, Evans ER and Hall IH. Pharmaceutical Packaging Technology. London, Taylor & Francis, 1st Edition. UK.
10. Edward J Bauer. Pharmaceutical Packaging Handbook. 2009. Informa Health care USA Inc. New york.
11. Shaybe Cox Gad. Pharmaceutical Manufacturing Handbook. John Willey and Sons, New Jersey, 2008.

QUALITY ASSURANCE PRACTICAL – II PRACTICALS
(MQA 205P)

1. Organic contaminants residue analysis by HPLC.
2. Estimation of Metallic contaminants by Flame photometer
3. Identification of antibiotic residue by TLC
4. Estimation of Hydrogen Sulphide in Air.
5. Estimation of Chlorine in Work Environment.
6. Sampling and analysis of SO_2 using Colorimetric method
7. Qualification of following Pharma equipment
   a. Autoclave
   b. Hot air oven
   c. Powder Mixer (Dry)
   d. Tablet Compression Machine
8. Validation of an analytical method for a drug
9. Validation of a processing area
10. Qualification of at least two analytical instruments
11. Cleaning validation of one equipment
12. Qualification of Pharmaceutical Testing Equipment (Dissolution testing apparatus, Friability Apparatus, Disintegration Tester)
13. Check list for Bulk Pharmaceutical Chemicals vendors
14. Check list for tableting production.
15. Check list for sterile production area
16. Check list for Water for injection.
17. Design of plant layout: Sterile and non-sterile
18. Case study on application of QbD
19. Case study on application of PAT

SEMESTER – III

RESEARCH METHODOLOGY & BIOSTATISTICS (MRM 301T)

UNIT – I

General Research Methodology: Research, objective, requirements, practical difficulties, types of research, scientific methods of research, types of studies, study design.

Review of literature - Sources of information. Searching of library documents and databases online and offline (Pubmed, Biological abstracts, other databases in pharmaceutical sciences). Introduction to internet searching using advanced search tools.

UNIT – II

Collection and analysis of data: Types of data and data collection techniques, processing of data, coding, tabulation and analysis of data.

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests (Student's t-test, ANOVA, Correlation coefficient, regression), non-parametric tests (Wilcoxan rank tests, analysis of variance, correlation, Chi square test), null hypothesis, P values, degree of freedom, interpretation of P values, different software for statistical analysis.

UNIT – III

Medical Research: History, values in medical ethics, strategies to eliminate errors/bias, controls, randomisation, cross over design, placebo, blinding techniques autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, vendor relationships, treatment of family members.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, location of animal facilities to laboratories, anaesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Technical writing, thesis/research report writing, structure of thesis, editing and formatting, reference citations, abstracting, plagiarism and paraphrasing, tools for writing good research report.

UNIT – VI

Research reporting - poster presentation, seminar and conference presentation, publishing in journals, copyright.

REFERENCE BOOKS

10. Atiya Khanum Irfan Ali Khan, Biostatistics for Pharmacy, 2nd Edition, 2007, UkaazPublications, Hyderabad.
11. C. George Thomas. Research Methodology and Scientific Writing First edition, 2016, AneBooks Pvt. Ltd.; New Delhi.
12. C. R Kothari. Research Methodology: Methods and Techniques. New Age International (P)Ltd, Publishers. New Delhi.

13. Mahajan, B.K. Methods in Biostatistics for Medical Students and Research workers, 7thEdition 2008 Jaypee Brothers.
14. Putul Mahanta , Medical Writing: A Guide for Medicos, Educators and Researchers JaypeeBrothers Medical Publishers; First edition (2018).
15. Ranjan Das, Biomedical Research Methodology: Including Biostatistical Applications. 1stEdn. Jaypee Brothers.
16. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 3rd Edition 2011,Sage Publications India Pvt. Ltd., New Delhi.
17. Sharma Suresh. Research Methodology and Biostatistics- A Comprehensive Guide for HealthCare Professionals. 1st Edn. Elsevier India.
18. Sunder Rao. P.S.S and Richard. J. An introduction to Biostatistics: A manual for students inhealth sciences. Prentice-Hall of India Pvt. Ltd Publishers.

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Q P CODE REG NO

MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL QUALITY ASSURANCE
FIRST SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - I – MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MQA 101T)

- Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Explain the theory of fluorescence. What are the factors affecting fluorescence?

2. Classify chromatographic methods based on mechanism of separation and add a note on column chromatography.

3. What is the principle of NMR spectroscopy? What are its applications?

Short notes (9X5=45)

4. Compare flame emission and atomic absorption spectroscopy.

5. Discuss about gel electrophoresis.

6. What is Bragg's law? Describe rotating crystal technique in x-ray crystallography.

7. Write a note on ion selective electrodes.

8. Discuss about the principle and instrumentation of differential thermal analysis.

9. Briefly explain the principle and working of potentiometer.

10. Write about MALDI. Explain principle and applications of MALDI.

11. Sample handing techniques in IR spectroscopy.

12. Write briefly on derivative UV spectroscopy.

Q P CODE REG NO

MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL QUALITY ASSURANCE
FIRST SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - II – QUALITY MANAGEMENT SYSTEM (MQA 102T)

- Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Discuss stability testing of drug substances according to ICH guideline.

2. Explain quality policy and objectives, strategic planning and implementation

3. Briefly explain risk assessment, risk management tools, risk ranking and filtering according to ICH Q9 guidelines.

Short notes (9X5=45)

4. Write a note on Classification of customers and factors affecting customer perception.

5. Write a note on Total Quality Management.

6. Write notes on

    a) Hazard Analysis and Critical Control Point (HACCP).

    b) McKinsey 7s model.

7. Write a note on Quality by Design according to ICH.

8. Discuss about Out of Specifications (OOS) and Out of Trend (OOT).

9. Write a note on procedure of NABL accreditation.

10. Write a note on Vendor Qualification.

11. Explain the advantages of statistical control and Process capability.

12. Briefly explain reasons, types, advantages and limitations of benchmarking.

Q P CODE REG NO

MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL QUALITY ASSURANCE
FIRST SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - III – QUALITY CONTROL & QUALITY ASSURANCE (MQA 103T)

- Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Write an informative note on purchase specifications and maintenance of stores for raw materials.

2. Write in detail protocol for conducting non-clinical testing and control on animal house.

3. What are the basic principles of documentation in Pharma industry? Discuss in detail about Master batch record and electronic data handling.

Short notes (9x5=45)

4. Write a short note on positive and negative aspects of IPR.

5. Discuss In-process quality control and finished process quality control for parenteral dosage form.

6. Write an informative note on three tier documentation.

7. Write a note on Good Warehousing practice.

8. What are the scopes of GLP in quality assurance unit?

9. Write a short note on handling of waste and scrap disposal.

10. Write an informative note on CTD.

11. Write a brief note on mix-ups and cross contamination.

12. Write a note on cGMP guidelines according to schedule M.

Q P CODE REG NO

MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL QUALITY ASSURANCE
FIRST SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - IV – PRODUCT DEVELOPMENT & TECHNOLOGY TRANSFER (MQA 104T)

- Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Enlist various ANDA certification clauses. Discuss in detail about para IV.

2. Discuss in detail the development of technology by R&D. Add a note on optimisation and quantitative technology models.

3. Write an informative note on solubility parameters that influence the pre-formulation study.

Short notes (9x5=45)

4. Discuss Hatch-Waxman amendment. What are its benefits?

5. Enumerate various centres run by FDA. Write an informative note on CFSAN.

6. Discuss different methods of post marketing surveillance.

7. Discus enteric and aseptic packaging systems.

8. Discuss quality control tests for glass and plastic containers.

9. What does SUPAC guidelines define? Discuss about SUPAC-IR.

10. Discuss the scale up study and manufacturing techniques of parenteral dosage forms.

11. Write a note on different techniques for the study of crystal properties and polymorphism.

12. Discuss the different techniques for the study of crystal properties and polymorphism.

Q P CODE REG NO

MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL QUALITY ASSURANCE
SECOND SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - I – HAZARDS & SAFETY MANAGEMENT (MQA 201T)

- Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Write in detail about ICH guidelines for risk assessment and risk management.

2. Explain the sources of chemical hazards. Discuss different control measures for its management.

3. Explain the preventive and protective management from fires and explosion. Add a note on its safety and hazards regulation.

Short notes (9x5=45)

4. Differentiate renewable and non-renewable resources.

5. Write a note on hazards based on radio isotopes.

6. Write in detail about accident prevention according to factory Act and rules.

7. How do you manage the combustible gases, toxic gases and Oxygen displacing gases?

8. Discuss in detail about types of toxins.

9. Explain how air circulation is maintained for sterile and non-sterile area in an industry.

10. Write a note on self-protective measures against workplace hazards.

11. Write a note on biological oxygen demand (BOD) and chemical oxygen demand (COD).

12. Write a note on preliminary hazard analysis (PHA).

Q P CODE REG NO

MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL QUALITY ASSURANCE
SECOND SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - II – PHARMACEUTICAL VALIDATION (MQA 202T)

- Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. What is qualification of analytical instruments? Write short note on calibration of HPLC, HPTLC and UV-Vis spectrophotometer.

2. What is process validation: Briefly discuss the USFDA guideline for process validation. Write short note on Process Validation of tablet coating.

3. Write a brief note on validation of analytical method as per ICH guidelines.

Short notes (9x5=45)

4. Briefly explain the Technology transfer. Draw the blank format for the TOT.

5. Draw the blank format for the Qualification of Disintegration tester and Dissolution test apparatus.

6. Explain cleaning method development and validation.

7. What is the difference between the calibration and validation? Explain the advantages of validation.

8. Enumerate the different step for patent filing. Explain the provisional and non-provisional patent.

9. Discuss the role of intellectual property in pharmaceutical industry.

10. Write note on qualification of Fluid Bed and Tray dryers.

11. What is the importance of Re-qualification?

12. Explain the factors affecting choice of IP protection.

Q P CODE REG NO

MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL QUALITY ASSURANCE
SECOND SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - III – AUDITS & REGULATORY COMPLIANCE (MQA 203T)

- Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Explain the auditing in granulation and tablet manufacturing process.

2. Discuss in detail about responsibilities, management and planning process of an audit.

3. Explain the cGMP regulations and quality system operations for audits in pharmaceutical manufacturing.

Short notes (9x5=45)

4. Explain Auditing of packaging.

5. Discuss in detail about audit checklist for capsules.

6. What is a compliance audit? What are the activities of compliance department?

7. How do internal auditors gather and analyse information.

8. Classify the deficiencies during audit.

9. Discuss in detail about audit checklist for drug industries.

10. Discuss auditing of microbiological laboratory.

11. Write a note on auditing of sterile production.

12. Explain in detail about auditing of HVAC system.

Q P CODE REG NO

MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL QUALITY ASSURANCE
SECOND SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER – IV – **PHARMACEUTICAL MANUFACTURING TECHNOLOGY (MQA 204T)**

- Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. What is QbD? Why is it required? Discuss different elements of QbD.
2. Explain the area planning, environment control and utilities of sterile product manufacturing.
3. Discuss how stability of packaging material is evaluated.

Short notes (9x5=45)

4. Discuss legal requirements for API and formulation in industry.
5. Discuss process automation with specific reference to sterile semisolid dosage form.
6. Write principle and equipment for lyophilisation.
7. Discuss the in-process quality control tests for compressed and coated tablets.
8. Write in detail about the stability aspects of packaging.
9. Write about different types of closures and closure liner.
10. Write a note on process analytical technology (PAT) guidance and its regulatory requirements.
11. Explain scheduling and dispatching of records in production plan.
12. Write a note on application techniques and problems encountered in coating technology.

KERALA UNIVERSITY OF HEALTH SCIENCES

Thrissur - 680596

SYLLABUS

POST GRADUATE COURSE IN PHARMACY

Master of Pharmacy (M. Pharm.)

PHARMACEUTICAL REGULATORY AFFAIRS	MRA
KUHS Course Code	529

(2022-23 Academic year onwards)

2022

Course of study for M.Pharm. I & II Semester

MRA	Pharmaceutical Regulatory Affairs				
Course Code	**Course**	**Credit Hours**	**Credit Points**	**Hrs./wk**	**Marks**
Semester I					
MRA 101T	Good Regulatory Practices	4	4	4	100
MRA 102T	Documentation and Regulatory Writing	4	4	4	100
MRA 103T	Clinical Research Regulations	4	4	4	100
MRA 104T	Drug Regulations & Intellectual Property Rights	4	4	4	100
MRA 105P	Regulatory Affairs Practical - I	12	6	12	150
-	Seminar/Assignment	7	4	7	100
Total		**35**	**26**	**35**	**650**
Semester II					
MRA 201T	Regulatory Aspects of Drugs & Cosmetics	4	4	4	100
MRA 202T	Regulatory Aspects of Herbals & Biologicals	4	4	4	100
MRA 203T	Regulatory Aspects of Medical Devices	4	4	4	100
MRA 204T	Regulatory Aspects of Food & Nutraceuticals	4	4	4	100
MRA 205P	Regulatory Affairs Practical – II	12	6	12	150
-	Seminar /Assignment	7	4	7	100
Total		**35**	**26**	**35**	**650**

Course of study for M. Pharm. III & IV Semester

Course Code	**Course**	**Credit Hours**	**Credit Points**	**Marks**
Semester III				
MRM 301T	Research Methodology and Biostatistics	4	4	100
-	Journal Club	1	1	25
-	Discussion / Presentation (proposal presentation)	2	2	25
-	Research Work	28	14	350
Total		**35**	**21**	**500**
Semester IV				
-	Journal Club	1	1	25
-	Pre submission Discussion / Presentation	3	3	75
-	Research Work	31	16	400
Total		**35**	**20**	**500**

PHARMACEUTICAL REGULATORY AFFAIRS (MRA)

SEMESTER I
GOOD REGULATORY PRACTICES (MRA 101T)

Scope:

This course is designed to impart fundamental knowledge on various Good Regulatory Practices viz., cGMP, GLP, GALP and GDP for Pharmaceuticals, Cosmetics, Food & Nutraceuticals, Medical devices, In-vitro Diagnostic Medical Devices (IVDs) and biological products and understand the rationale behind these requirements and will propose ways and means of complying with them.

Objectives:

At completion of this course it is expected that students will be able to understand,

- The key regulatory and compliance elements with respect to Good Manufacturing Practices, Good Laboratory Practices, Good Automated Laboratory Practices and Good Documentation Practices.
- Prepare and implement the check lists and SOPs for various Good Regulatory Practices
- Implement Good Regulatory Practices in the Healthcare and related Industries
- Prepare for the readiness and conduct of audits and inspections.

THEORY **60 Hrs**

1. **Current Good Manufacturing Practices:** 12 Hrs

Introduction:, US cGMP Part 210 and Part 211.EC Principles of GMP (Directive 91/356/EEC) Article 6 to Article 14 and WHO cGMP guidelines GAMP-5; Medical device and IVDs Global Harmonization Task Force(GHTF) Guidance docs.

2. **Good Laboratory Practices:** 1 2 H rs

Introduction, USFDA GLP Regulations (Subpart A to Subpart K), Controlling the GLP inspection process, Documentation, Audit, goals of Laboratory Quality Audit, Audit tools, Future of GLP regulations, relevant ISO and Quality Council of India(QCI) Standards

3. **Good Automated Laboratory Practices:** 12 Hrs

Introduction to GALP,Principles of GALP, GALP Requirements, SOPs of GALP,Training Documentation, 21 CFR Part 11, General check list of21CFR Part 11, Software Evaluation checklist, relevant ISO and QCI Standards.

4. **Good Distribution Practices:** 12 Hrs

Introduction to GDP, Legal GDP requirements put worldwide, Principles, Personnel, Documentation, Premises and Equipment, Deliveries to Customers, Returns, Self-Inspection, Provision of information, Stability testing principles, WHO GDP, USP GDP (Supply chain integrity), relevant CDSCO guidance and ISO standards

5. **Quality management systems:** 12 Hrs

Concept of Quality, Total Quality Management, Quality by design, Six Sigma concept, Out of Specifications (OOS), Change control. Validation: Types of Validation, Types of Qualification, Validation master plan (VMP), Analytical Method Validation. Validation of utilities, [Compressed air, steam, water systems, Heat Ventilation and Air conditioning (HVAC)]and Cleaning Validation. The International Conference on Harmonization (ICH) process, ICH guidelines to establish quality, safety and efficacy of drug substances and products, ISO 13485, Sch MIII and other relevant CDSCO regulatory guidance documents.

REFERENCES

1. Good Laboratory Practice Regulations, by Sandy Weinberg, Fourth EditionDrugs and the Pharmaceutical Sciences, Vol.168
2. Good Pharmaceutical Manufacturing practice, Rational and compliance byJohn Sharp, CRC Press

3. Establishing a cGMP Laboratory Audit System, A practical Guide by David M. Bleisner, Wiley Publication.
4. How to practice GLP by PP Sharma, Vandana Publications.
5. Laboratory Auditing for Quality and Regulatory compliance by DonaldC. Singer, Drugs and the Pharmaceutical Sciences, Vol.150
6. Drugs & Cosmetics Act, Rules & Amendments

DOCUMENTATION AND REGULATORY WRITING (MRA 102T)

Scope:

This course is designed to impart fundamental knowledge on documentationand general principles involved in regulatory writing and submission to agencies.

Objectives:

Upon completion of the course the student shall be able to,

- _ Know the various documents pertaining to drugs in pharmaceuticalindustry
- _ Understand the basics of regulatory compilation
- _ Create and assemble the regulation submission as per therequirements of agencies
- _ Follow up the submissions and post approval document requirements

THEORY **60 Hrs**

1. **Documentation in pharmaceutical industry:** 12 Hrs

Exploratory Product Development Brief (EPDB) for Drug substance and Drug product, Product Development Plan (PDP), Product Development Report (PDR), Master Formula Record, Batch Manufacturing Record and its calculations, Batch Reconciliation, Batch Packaging Records, Print pack specifications, Distribution records, Certificate of Analysis (CoA), Site Master File and Drug Master Files (DMF).

2. **Dossier preparation and submission:** 12 hrs

Introduction and overview of dossiers, contents and organization of dossier, binders and sections, compilation and review of dossier. Paper submissions, overview and modules of CTD, electronic CTD submissions; Electronic submission: Planning electronic submission, requirements for submission, regulatory bindings and requirements, Tool and Technologies, electronic dossier submission process and validating the submission, Electronic Submission Gateway (ESG). Non eCTD electronic submissions (NeeS), Asian CTD formats (ACTD) submission. Organizing, process and validation of submission. Submission in Sugam system of CDSCO.

3. **Audits:** 12 Hrs

Introduction, Definition, Summary, Types of audits, GMPcompliance audit, Audit policy, Internal and External Audits, Second Party Audits, External third party audits, Auditing strategies, Preparation and conducting audit, Auditing strategies, audit analysis, audit report, audit follow up. Auditing/inspection of manufacturing facilities by regulatory agencies. Timelines for audits/inspection. GHTF study group 4 guidance document. ISO 13485.

4.**Inspections:** 12Hrs

Pre-approval inspections, Inspection of pharmaceutical manufacturers, Inspection of drug distribution channels, Quality systems requirements for national good manufacturing practice inspectorates, inspection report, model certificate of good manufacturing practices, Root cause analysis, Corrective and Preventive action (CAPA).

5. **Product life cycle management:** 12 Hrs

Prior Approval Supplement (PAS), Post Approval Changes [SUPAC], Changes Being Effected in 30 Days (CBE-30), Annual Report, Post marketing Reporting Requirements, Post approval Labeling Changes, Lifecycle Management, FDA Inspection and Enforcement, Establishment Inspection Report (EIR), Warning Letters, Recalls, Seizure and Injunctions. ISO Risk Management Standard

REFERENCES:

1. Compliance auditing for Pharmaceutical Manufacturers. Karen Ginsbury and Gil Bismuth, Interpharm/CRC, Boca Raton, London New York, Washington D.C.
2. Pharmaceutical Manufacturing Handbook, Regulations and Quality by Shayne Cox Gad. Wiley-Interscience, A John Wiley and sons, Inc., Publications.
3. Handbook of microbiological Quality control. Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyar. CRC Press. 2000.
4. Laboratory auditing for quality and regulatory compliance. Donald C. Singer, Raluca-loana Stefan, Jacobus F. Van Staden. Taylor and Francis (2005).
5. Implementing Juran's Road Map for Quality Leadership: Benchmarks and Results, By Al Endres, Wiley, 2000
6. Understanding, Managing and Implementing Quality: Frameworks, Techniques and Cases, By Jiju Antony; David

Preece, Routledge, 2002

7. Organizing for High Performance: Employee Involvement, TQM, Reengineering, and Knowledge Management in the Fortune 1000: The CEO Report By Edward E. Lawler; Susan Albers Mohrman; George Benson, Jossey-Bass, 2001
8. Corporate Culture and the Quality Organization By James W. Fairfield- Sonn, Quorum Books, 2001
9. The Quality Management Sourcebook: An International Guide to Materials and Resources By Christine Avery; Diane Zabel, Routledge, 1997
10. The Quality Toolbox, Second Edition, Nancy R. Tague, ASQ Publications
11. Juran's Quality Handbook, Sixth Edition, Joseph M. Juran and Joseph A. De Feo, ASQ Publications
12. Root Cause Analysis, The Core of Problem Solving and Corrective Action, Duke Okes, 2009, ASQ Publications
13. International Medical Device Regulators Forum (IMDRF) Medical Device Single Audit Program (MDSAP)

CLINICAL RESEARCH REGULATIONS (MRA 103T)

Scope:

This course is designed to impart the fundamental knowledge on the clinical development process of drugs, pharmaceuticals and Medical Devices, phases and conduct of clinical trials and research, regulations and guidance governing the conduct of clinical research in India, USA and EU. It prepares the students to learn in detail on various laws, legislations and guidance related to safety, efficacy, ethical conduct and regulatory approval of clinical research.

Objectives:

Upon completion of the course, the student shall be able to (know, do andappreciate)

- History, origin and ethics of clinical and biomedical research andevaluation
- Clinical drug, medical device development process and different typesand phases of clinical trials
- Regulatory requirements and guidance for conduct of clinical trials andresearch

THEORY **60 Hrs**

1. **Clinical Drug Development Process:** 12 Hrs
   - Different types of Clinical Studies
   - Phases of clinical trials, Clinical Trial protocol
   - Phase 0studies
   - Phase I and subtype studies (single ascending, multiple ascending, dose escalation, methods, food effect studies, drug – drug interaction, PK endpoints
   - Phase IIstudies (proof of concept or principle studies to establish efficacy)
   - Phase IIIstudies (Multi ethnicity, global clinical trial, registration studies)
   - Phase IV studies (Post Marketing Studies; PSUR)

   Clinical Investigation and Evaluation of Medical Devices & IVDs

2 **Ethics in Clinical Research:** 12 Hrs

   - Historical Perspectives: Nuremberg Code, Thalidomide study, Nazis Trials, Tuskegee Syphilis Study, The Belmont Report,The declaration of Helsinki
   - Origin of International Conference on Harmonization - GoodClinical Practice (ICH-GCP) guidelines.
   - The ethics of randomized clinical trials
   - The role of placebo in clinical trials
   - Ethics of clinical research in special population
   - Institutional Review Board/Independent Ethics Committee/Ethics Committee – composition, roles, responsibilities, review and approval process and ongoing monitoring of safety data
   - Data safety monitoring boards.
   - Responsibilities of sponsor, CRO, and investigator in ethical conduct of clinical research
   - Ethical principles governing informed consent process
   - Patient Information Sheet and Informed Consent Form
   - The informed consent process and documentation

3 **Regulations g o v e r n i n g Clinical Trials** 12 Hrs

   India: Clinical Research regulations in India – Schedule Y & Medical Device Guidance

   USA: Regulations to conduct drug studies in USA (FDA)

   - NDA 505(b)(1) of the FD&C Act (Application for approval of a new drug)
   - NDA 505(b)(2) of the FD&C Act (Application for approval of a new drug that relies, at least in part, on data not developed by the applicant)
   - ANDA 505(j) of the FD&C Act (Application for approval of a generic drug product)
   - FDA Guidance for Industry - Acceptance of Foreign Clinical Studies
   - FDA Clinical Trials Guidance Document: Good ClinicalPractice

   EU: Clinical Research regulations in European Union (EMA)

4 **Clinical Research R e l a t e d Guidelines** 12 Hrs

   - Good Clinical Practice Guidelines (ICH GCP E6)

_ Indian GCP Guidelines
_ ICMR Ethical Guidelines for Biomedical Research
_ CDSCO guidelines
GHTF study group 5 guidance documents
Regulatory Guidance on Efficacy and Safety ICH Guidance's
_ E4 – Dose Response Information to support DrugRegistration
_ E7 – Studies in support of General Population: Geriatrics
_ E8 – General Considerations of Clinical Trials
_ E10 – Choice of Control Groups and Related Issues inClinical Trials,
_ E 11 – Clinical Investigation of Medicinal Products in thePediatric Population
_ General biostatics principle applied in clinical research

5 USA & EU GuidanceUSA: FDA Guidance 12 Hrs

_ CFR 21Part 50: Protection of Human Subjects
_ CFR 21Part 54: Financial Disclosure by Clinical Investigators
_ CFR 21Part 312: IND Application
_ CFR 21Part 314: Application for FDA Approval to Market aNew Drug
_ CFR 21Part 320: Bioavailability and bioequivalencerequirements
_ CFR 21Part 812: Investigational Device Exemptions
_ CFR 21Part 822: Post-market surveillance
_ FDA Safety Reporting Requirements for INDs and BA/BE Studies
_ FDA Med Watch
_ Guidance for Industry: Good Pharmacovigilance Practicesand Pharmacoepidemiologic Assessment
European Union: EMA Guidance
_ EU Directives 2001
_ EudraLex (EMEA) Volume 3 – Scientific guidelines formedicinal products for human use
_ EU Annual Safety Report (ASR)
_ Volume 9A – Pharmacovigilance for Medicinal Products forHuman Use
_ EU MDD with respect to clinical research
_ ISO 14155

REFERENCES

1. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams
2. HIPAA and Human Subjects Research: A Question and Answer Reference Guide By Mark Barnes, JD, LLM and Jennifer Kulynych, JD, PhD
3. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
4. Reviewing Clinical Trials: A Guide for the Ethics Committee; Johan PE Karlberg and Marjorie A Speers; Karlberg, Johan Petter Einar, Hong Kong.
5. International Pharmaceutical Product Registration: Aspects of Quality, Safety and Efficacy; Anthony C. Cartwright; Taylor & Francis Inc., USA.
6. New Drug Approval Process: The Global Challenge; Guarino, Richard A; Marcel Dekker Inc., NY.
7. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics; Douglas J. Pisano, David Mantus; CRC Press, USA
8. Country Specific Guidelines from official websites.
9. Drugs & Cosmetics Act & Rules and Amendments

RECOMMENDED WEBSITES:

1. EU Clinical Research Directive 2001: http://www.eortc.be/services/doc/clinical-eudirective-04-april-01.pdf
2. Code of Federal Regulations, FDA: http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm
3. Guidelines of International Conference on Harmonization: http://www. ich.org/products/guidelines.html
4. Eudralex Guidelines: http://www.gmpcompliance.info/euguide.htm
5. FDA New Drug Application: http://www.fda.gov/regulatoryinformation/legislation/FederalFoodDrugandCosmetic ActFDCAct/FDCActChapterVDrugsandDevices/ucm108125.htm
6. Medicines and Healthcare products Regulatory Agency: http://www.mhra.gov.uk
7. Central Drugs Standard Control Organization Guidance for Industry:http://cdsco.nic.in/CDSCO-GuidanceForIndustry.pdf
8. ICMR Ethical Guidelines for Biomedical Research: http://icmr.nic.in/ethical_guidelines.pdf

DRUG REGULATIONS AND INTELLECTUAL PROPERTY RIGHTS (MRA 104T)

Scope:

This course is designed to impart fundamental knowledge on regulations and legislation in India w.r.t. Drugs & Cosmetics, Medical Devices, Biologicals & Herbals, and Food & Nutraceuticals. It prepares the students for basic regulatory requirements in India of Drugs & Cosmetics, Medical Devices, Biologicals & Herbals, and Food & Nutraceuticals. for manufacture, import & registration, export, sale, marketing authorization, clinical trials and intellectual property rights.

Objectives:

Upon the completion of the course the student shall be able to:

- Know different Acts and guidelines that regulate Drugs & Cosmetics, Medical Devices, Biologicals & Herbals, and Food & Nutraceuticals industry in India.
- Understand the approval process and regulatory requirements for Drugs & Cosmetics, Medical Devices, Biologicals & Herbals, and Food & Nutraceuticals

THEORY **60 Hrs**

1. **Biologicals & Herbals, and Food & NutraceuticalsActs and Rules (with latest amendments):** 12 Hrs

(1) Drugs and Cosmetics Act 1940 and Rules 1945: DPCO and NPPA

(2) Other relevant provisions (rules schedules and guidelines for approval of Drugs & Cosmetics, Medical Devices, Biologicals & Herbals, and Food & Nutraceuticals in India

Other relevant Acts: Narcotics Drugs and Psychotropic Substances Act; Medicinal and Toilet Preparations (Excise Duties) Act, 1955; Pharmacy Act, 1948; Drugs and Magic Remedies (Objectionable Advertisements) Act, 1955; Prevention of Cruelty to Animals Act.

2. **Regulatory requirements and approval procedures for Drugs & Cosmetics Medical Devices, Biologicals & Herbals, and Food & Nutraceuticals:** 12 Hrs

CDSCO (Central Drug Standard Control Organization) and State Licensing Authority: Organization, Responsibilities

- Rules, regulations, guidelines and standards for regulatory filing of Drugs & Cosmetics, Medical Devices, Biologicals & Herbals, and Food & Nutraceuticals
- Format and contents of Regulatory dossier filing Clinical trial/ investigations

3. **Indian Pharmacopoeial Standards, BIS standards and ISO and other relevant standards** 12 Hrs

4. Bioavailability and Bioequivalence data (BA &BE), BCS Classification of Drugs, Regulatory Requirements for Bioequivalence study 12 Hrs
Stability requirements: ICH and WHO

Guidelines for Drug testing in animals/Preclinical Studies

Animal testing: Rationale for conducting studies, CPCSEAGuidelines
Ethical guidelines for human participants ICMR-DBT Guidelines for Stem Cell Research

5. **Intellectual Property Rights:** 12 Hrs
Patent, Trademark, Copyright, Industrial Designs and Geographical Indications, Indian Patent Scenario. IPR vs Regulatory Affairs

REFERENCES

1. Manual of Patent Practice & Procedure, 3rd Edition, by The Patent Officeof India.
2. Patent Failure How Judges, Bureaucrats, and Lawyers put innovators atrisk by James Bessen and Michael J. Meurer.
3. Principles and Practice of Clinical Trial Medicine by Richard Chin andBruce Y. Lee.
4. Ethical Guidelines for Biomedical Research on Human Participants byIndian Council of Medical Research New Delhi 2006.
5. CPCSEA Guidelines for Laboratory Animal Facility by Committee for thepurpose of control and supervision on experiments on animals (CPCSEA).

6. ICH E6 Guideline — Good Clinical Practice| by ICH Harmonised Tripartite
7. Guidance for Industry on Submission of Clinical Trial Application for Evaluating Safety and Efficacy by CDSCO (Central Drug Standard Control Organisation)
8. Guidance for Industry on Requirement of Chemical & Pharmaceutical Information including Stability Study Data before approval of clinical trials / BE studies by CDSCO
9. Guidelines for Import and Manufacture of Medical Devices by CDSCO
10. Guidelines from official website of CDSCO

REGULATORY AFFAIRS PRACTICAL – I (MRA 105P)

1. Case studies (4 Nos.) of each of Good Pharmaceutical Practices.
2. Documentation for in process and finished products Quality control tests for Solid, liquid, Semisolid and Sterile preparations.
3. Preparation of SOPs, Analytical reports (Stability and validation)
4. Protocol preparation for documentation of various types of records (BMR,MFR, DR)
5. Labeling comparison between brand & generics.
6. Preparation of clinical trial protocol for registering trial in India
7. Registration for conducting BA/ BE studies in India
8. Import of drugs for research and developmental activities
9. Preparation of regulatory dossier as per Indian CTD format and submissionin SUGAM
10. Registering for different Intellectual Property Rights in India
11. GMP Audit Requirements as per CDSCO
12. Preparation and documentation for Indian Patent application.
13. Preparation of checklist for registration of IND as per ICH CTD format.
14. Preparation of checklist for registration of NDA as per ICH CTD format.
15. Preparation of checklist for registration of ANDA as per ICH CTD format.
16. Case studies on response with scientific rationale to USFDA Warning Letter
17. Preparation of submission checklist of IMPD for EU submission.
18. Comparison study of marketing authorization procedures in EU.
19. Comparative study of DMF system in US, EU and Japan
20. Preparation of regulatory submission using eCTD software
21. Preparation of Clinical Trial Application (CTA) for US submission
22. Preparation of Clinical Trial Application (CTA) for EU submission
23. Comparison of Clinical Trial Application requirements of US, EU and Japanof a dosage form.
24. Regulatory requirements checklist for conducting clinical trials in India.
25. Regulatory requirements checklist for conducting clinical trials in Europe.
26. Regulatory requirements checklist for conducting clinical trials in USA

SEMESTER II

REGULATORY ASPECTS OF DRUGS & COSMETICS (MRA 201T)

Scope

This course is designed to impart the fundamental knowledge on the drug development process, regulatory requirements for approval of new drugs, drug products and cosmetics in regulated and semi-regulated countries. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products and cosmetics in regulated and semi-regulated countries.

Objectives:

Upon completion of the course, the student shall be able to know

- Process of drug discovery and development and generic productdevelopment
- Regulatory approval process and registration procedures for API anddrug products in US, EU
- Cosmetics regulations in regulated and semi-regulated countries
- A comparative study of India with other global regulated markets

THEORY **60 Hrs**

1. **USA & CANADA:** 12 Hrs

Organization structure and functions of FDA. Federal register and Code of Federal Regulations (CFR), History and evolution of United States Federal, Food, Drug and Cosmetic Act (FFDCA), Hatch Waxman act and Orange book, Purple book, Drug Master Files (DMF) system in US, Regulatory Approval

Process for Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA), Supplemental New Drug Application (SNDA); Regulatory requirements for Orphan drugs and Combination Products, Changes to an approved NDA / ANDA. Regulatory considerations for manufacturing, packaging and labeling of pharmaceuticals in USA. Legislation and regulations for import, manufacture, distribution and sale of cosmetics in USA and Canada.

2. **European Union & Australia:** 1 2 H r s

Organization and structure of EMA & EDQM, General guidelines, Active Substance Master Files (ASMF) system in EU, Content and approval process of IMPD, Marketing Authorization procedures in EU (Centralized procedure, Decentralized procedure, Mutual recognition procedure and National Procedure). Regulatory considerations for manufacturing, packaging and labeling of pharmaceuticals in EU, Eudralex directives for human medicines, Variations & extensions, Compliance of European Pharmacopoeia (CEP)/ Certificate of Suitability (CoS), Marketing Authorization (MA) transfers, Qualified Person (QP) in EU. Legislation and regulations for import, manufacture, distribution and sale of cosmetics in European Union & Australia.

3. **Japan:** 12 Hrs

Organization of the PMDA, Pharmaceutical Laws and regulations, types of registration applications, DMF system in Japan, drug regulatory approval process, Regulatory considerations for manufacturing, packaging and labeling of pharmaceuticals in Japan, Post marketing surveillance in Japan. Legislation and regulations for import, manufacture, distribution and sale of cosmetics in Japan

4. **Emerging Market:** 12 Hrs

Introduction, Countries covered, Study of the world map, study of various committees across the globe (ASEAN, APEC, EAC, GCC, PANDRH, SADC)

WHO: WHO, GMP, Regulatory Requirements for registration of drugs and post approval requirements in WHO through prequalification programme, Certificate of Pharmaceutical Product (CoPP) - General and Country Specific (South Africa, Egypt, Algeria and Morocco, Nigeria, Kenya and Botswana)

5. **Brazil, ASEAN, CIS and GCC Countries:** 12 Hrs

ASIAN Countries: Introduction to ACTD, R e g u l a t o r y Requirements for registration of drugs and post approval requirements in China and South Korea & Association of Southeast Asian Nations (ASEAN) Region i.e. Vietnam, Malaysia, Philippines, Singapore and Thailand.

CIS (Commonwealth Independent States): Regulatory pre- requisites related to Marketing authorization requirements for drugs and post approval requirements in CIS countries i.e. Russia, Kazakhstan and Ukraine GCC (Gulf Cooperation Council) for Arab states: Regulatory pre-requisites related to Marketing authorization requirements for drugs and post approval requirements in Saudi Arabia and UAE

Legislation and regulations for import, manufacture, distribution and sale of cosmetics in Brazil, ASEAN, CIS and GCC Countries.

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 Drugs Approval Process: Accelerating Global Restrictions By Richard A. Guarino MD, 5th Edn, Drugs and Pharmaceuticals, Vol. 190.
5. Guidebook for drug regulatory submissions / Sandy Weinberg. By JohnWiley & Sons. Inc.
6. Drugs: From Discovery to Approval, Second Edition By Rick Ng
7. New Drug Development: A Regulatory Overview, Eighth Edition By MarkMathieu
8. Pharmaceutical Risk Management By Jeffrey E. Fetterman, Wayne L. Pines and Gary H. Slatko
9. Preparation and Maintenance of the IND Application in eCTD Format ByWilliam K. Sietsema
10. Country Specific Guidelines from official websites.
11. http://www.who.int/medicines/areas/quality_safety/regulation_legislation/ ListMRAWebsites.pdf
12. Roadmap to an ASEAN economic community Edited by Denis Hew. ISEAS Publications, Singapore 2005, ISBN981-230-347-2
13. ASEAN, Rodolfo C. Severino, ISEAS Publications, Singapore 2005, ISBN 978-981-230-750-7
14. Building a Future with Brics: The Next Decade for Offshoring, Mark Kobayashi-Hillary, Springer
15. Outsourcing to India: The Offshore Advantage, Mark Kobayashi-Hillary, Springer Trade performance and Regional Integration of the CIS Countries, Lev Freinkman,
16. The world Bank, Washington, DC, ISBN: 0-8212-5896-0
17. Global Pharmaceutical Policy: Ensuring Medicines for Tomorrow's World ByFrederick M. Abbott, Graham Dukes, Maurice Nelson Graham Dukes 139
18. The Gulf Cooperation Council: A Rising Power and Lessons for ASEAN by Linda Low and Lorraine Carlos Salazar (Nov 22, 2010)
19. Doing Business in the Asean Countries, Balbir Bhasin, Business Expert Press ISBN:13:978-1-60649-108-9
20. Realizing the ASEAN Economic Community: A Comprehensive Assessment, Michael G Plummer (Editor), Chia Siow Yue (Editor), Instute of South East Asian studies, Singapore.

REGULATORY ASPECTS OF HERBAL AND BIOLOGICALS (MRA 202T)

Scope

This course is designed to impart fundamental knowledge on Regulatory Requirements, Licensing and Registration, Regulation on Labelling of Biologics in India, USA and Europe
It prepares the students to learn in detail on Regulatory Requirements for
biologics, Vaccines and Blood Products

Objectives

Upon the completion of the course the student shall be able to:

- Know the regulatory Requirements for Biologics and Vaccines
- Understand the regulation for newly developed biologics and biosimilars
- Know the pre-clinical and clinical development considerations of biologics
- Understand the Regulatory Requirements of Blood and/or Its Components Including Blood Products and label requirements

THEORY **60 Hrs**

1. India: 12 Hrs

Introduction, Applicable Regulations and Guidelines, Principles for Development of Similar Biologics, Data Requirements for Preclinical Studies, Data Requirements for Clinical Trial Application, Data Requirements for Market Authorization Application, Post-Market Data for Similar Biologics, Pharmacovigilance. GMP and GDP.

2. USA: 12 Hrs

Introduction to Biologics; biologics, biological and biosimilars, different biological products, difference between generic drug and biosimilars, laws, regulations and guidance on biologics/ biosimilars, development and approval of biologics and biosimilars (IND, PMA, BLA, NDA, 510(k), pre-clinical and clinical development considerations, advertising, labelling and packing of biologics

3. European Union: 12 Hrs

Introduction to Biologics; directives, scientific guidelines and guidance related to biologics in EU, comparability/ biosimilarity assessment, Plasma master file, TSE/ BSE evaluation, development and regulatory approval of biologics (Investigational medicinal products and biosimilars), pre-clinical and clinical development considerations; stability, safety,advertising, labelling and packing of biologics in EU.

4. Vaccine regulations in India, US and European Union: 12 Hrs

Clinicalevaluation, Marketing authorisation, Registration or licensing, Quality assessment, Pharmacovigilance, Additional requirements Blood and Blood Products Regulations in India, US and EuropeanUnion: Regulatory Requirements of Blood and/or Its Components Including Blood Products, Label Requirements, ISBT(International Society of Blood Transfusion) and IHN (International Haemovigilence Network)

5. Herbal Products: 12 Hrs

Quality, safety and legislation for herbalproducts in India, USA and European Union.

REFERENCES

1. FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices,and Biologics, Douglas J. Pisano, David S. Mantus; Informa ,2008
2. Biological Drug Products: Development and Strategies; WeiWang, Manmohan Singh; Wiley ,2013
3. Development of Vaccines: From Discovery to Clinical Testing; ManmohanSingh, Indresh K. Srivastava; Wiley, 2011
4. www.who.int/biologicals/en
5. www.fda.gov/BiologicsBloodVaccines/GuidanceComplianceRegulatoryInformation/
6. www.ihn-org.com
7. www.isbtweb.org
8. Guidelines on Similar Biologics: Regulatory Requirements for MarketingAuthorization in India
9. www.cdsco.nic.in
10. www.ema.europa.eu › scientific guidelines › Biologicals
11. www.fda.gov/biologicsbloodVaccines/GuidanceCompliance Regulatory Information (Biologics)

REGULATORY ASPECTS OF MEDICAL DEVICES (MRA 203T)

Scope:

This course is designed to impart the fundamental knowledge on the medical devices and in vitro diagnostics, basis of classification and product life cycle of medical devices, regulatory requirements for approval of medical devices in regulated countries like US, EU and Asian countries along with WHO regulations. It prepares the students to learn in detail on the harmonization initiatives, quality and ethical considerations, regulatory and documentation requirements for marketing medical devices and IVDs in regulated countries.

Objectives:

Upon completion of the course, the student shall be able to know

- basics of medical devices and IVDs, process of development, ethicaland quality considerations
- harmonization initiatives for approval and marketing of medical devicesand IVDs
- regulatory approval process for medical devices and IVDs in India, US,Canada, EU, Japan and ASEAN
- clinical evaluation and investigation of medical devices and IVDs

THEORY **60 Hrs**

1. **Medical Devices:** 12 Hrs

Introduction, Definition, Risk based classification and Essential Principles of Medical Devices and IVDs. Differentiating medical devices IVDs and Combination Products from that of pharmaceuticals, History of Medical Device Regulation, Product Lifecycle of Medical Devices andClassification of Medical Devices.
IMDRF/GHTF: Introduction, Organizational Structure, Purpose and Functions, Regulatory Guidelines, Working Groups, Summary Technical Document (STED), Global Medical Device Nomenclature (GMDN).

2. **Ethics:** 1 2 H rs

Clinical Investigation of Medical Devices, ClinicalInvestigation Plan for Medical Devices, Good Clinical Practice for Clinical Investigation of medical devices (ISO 14155:2011) Quality: Quality System Regulations of Medical Devices: ISO13485, Quality Risk Management of Medical Devices: ISO14971, Validation and Verification of Medical device, AdverseEvent Reporting of Medical device

3. **USA:** 12 Hrs

Introduction, Classification, Regulatory approval process for Medical Devices (510k) Premarket Notification, Pre-Market Approval (PMA), Investigational Device Exemption (IDE) and In vitro Diagnostics, Quality System Requirements 21 CFR Part 820,Labeling requirements 21 CFR Part 801, Post marketing surveillance of MD and Unique Device Identification (UDI). Basics of In vitro diagnostics, classification and approval process.

4. **European Union:** 12 Hrs

Introduction, Classification, Regulatory approval process for Medical Devices
(Medical Device Directive, Active Implantable Medical Device Directive) and In vitro Diagnostics (In Vitro Diagnostics Directive),CE certification process.
Basics of In vitro diagnostics, classification and approval process.

5. **ASEAN, China & Japan:** 12 Hrs

Medical Devices and IVDs, Regulatory registration procedures, Quality System requirements and clinical evaluation and investigation.
IMDRF study groups and guidance documents.

REFERENCES

1. FDA regulatory affairs: a guide for prescription drugs, medical devices, andbiologics by Douglas J. Pisano, David Mantus.
2. Medical Device Development: A Regulatory Overview by Jonathan S. Kahan
3. Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics, Medical Devices by John J. Tobin and Gary Walsh
4. Compliance Handbook for Pharmaceuticals, Medical Devices andBiologics by Carmen Medina
5. Country Specific Guidelines from official websites.

REGULATORY ASPECTS OF FOOD & NUTRACEUTICALS (MRA 204T)

Scope:

This course is designed to impart the fundamental knowledge on Regulatory Requirements, Registration and Labeling Regulations of Nutraceuticals in India, USA and Europe.
It prepares the students to learn in detail on Regulatory Aspects for nutraceuticals and food supplements.

Objectives:

Upon completion of the course, the student shall be able to

- Know the regulatory Requirements for nutraceuticals
- Understand the regulation for registration and labeling of nutraceuticalsand food supplements in India, USA and Europe.

THEORY **60 Hrs**

1. **Nutraceuticals:** 12 Hrs

Introduction, History of Food and Nutraceutical Regulations, Meaning of Nutraceuticals, Dietary Supplements, Functional Foods, Medical Foods, Scope and Opportunities in Nutraceutical Market.

2. **Global Aspects**: 12 Hrs

WHO guidelines on nutrition. NSF International: Its Role in the Dietary Supplements and Nutraceuticals Industries, NSF Certification, NSF Standards for Food and Dietary Supplements. Good Manufacturing Practices for Nutraceuticals.

3. **India:** 12 Hrs

Food Safety and Standards Act, Food Safety and Standards Authority of India: Organization and Functions, Regulations for import, manufacture and sale of nutraceutical products in India, Recommended Dietary Allowances (RDA) in India.

4. **USA:** 12 Hrs

US FDA Food Safety Modernization Act, Dietary Supplement Health and Education Act. U.S. regulations for manufacture and sale of nutraceuticals and dietary supplements, Labelling Requirements and Label Claims for Dietary Supplements, Recommended Dietary Allowances (RDA) in the U.S

5. **European Union:** 12 Hrs

European Food Safety Authority (EFSA): Organization and Functions. EU Directives and regulations for manufacture and sale of nutraceuticals and dietary supplements. Nutrition labelling. European Regulation on Novel Foods and Novel Food Ingredients. Recommended Dietary Allowances (RDA) in Europe.

REFERENCES

1. Regulation of Functional Foods and Nutraceuticals: A Global Perspectiveby Clare M. Hasler (Wiley Online Library)
2. Nutraceutical and Functional Food Regulations in the United States andAround the World by Debasis Bagchi (Academic Press, Elsevier)
3. http://www.who.int/publications/guidelines/nutrition/en/
4. http://www.europarl.europa.eu/RegData/etudes/STUD/2015/536324/IPOL_ STU(2015)536324_EN.pdf
5. Handbook of Nutraceuticals by Yashwant Pathak (CRC Press)
6. Food Regulation: Law, Science, Policy and Practice by Neal D. Fortin(Wiley)
7. Country Specific Guidelines from official websites.

REGULATORY AFFAIRS PRACTICAL - II(MRA 205P)

1. Case studies on
2. Change Management/ Change control. Deviations
3. Corrective & Preventive Actions (CAPA)
4. Documentation of raw materials analysis as per official monographs
5. Preparation of audit checklist for various agencies
6. Preparation of submission to FDA using eCTD software
7. Preparation of submission to EMA using eCTD software
8. Preparation of submission to MHRA using eCTD software
9. Preparation of Biologics License Applications (BLA)
10. Preparation of documents required for Vaccine Product Approval
11. Comparison of clinical trial application requirements of US, EU andIndia of Biologics
12. Preparation of Checklist for Registration of Blood and Blood Products
13. Registration requirement comparison study in 5 emerging markets (WHO) and preparing check list for market authorization
14. Registration requirement comparison study in emerging markets (BRICS) and preparing check list for market authorization
15. Registration requirement comparison study in emerging markets (China and South Korea) and preparing check list for market authorization
16. Registration requirement comparison study in emerging markets (ASEAN) and preparing check list for market authorization
17. Registration requirement comparison study in emerging markets (GCC) and preparing check list for market authorization
18. Checklists for 510k and PMA for US market
19. Checklist for CE marking for various classes of devices for EU
20. STED Application for Class III Devices
21. Audit Checklist for Medical Device Facility
22. Clinical Investigation Plan for Medical Devices

SEMESTER-III

RESEARCH METHODOLOGY & BIOSTATISTICS (MRM 301T)

UNIT –I

General Research Methodology: Research, objective, requirements, practical difficulties, types of research, scientific methods of research, types of studies, study design.

Review of literature - Sources of information. Searching of library documents and databases online and offline (Pubmed, Biological abstracts, other databases in pharmaceutical sciences). Introduction to internet searching using advanced search tools.

UNIT – II

Collection and analysis of data: Types of data and data collection techniques, processing of data, coding, tabulation and analysis of data.

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests (Student's t-test, ANOVA, Correlation coefficient, regression), non-parametric tests (Wilcoxan rank tests, analysis of variance, correlation, Chi square test), null hypothesis, P values, degree of freedom, interpretation of P values, different software for statistical analysis.

UNIT – III

Medical Research: History, values in medical ethics, strategies to eliminate errors/bias, controls, randomisation, cross over design, placebo, blinding techniques autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, vendor relationships, treatment of family members.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, location of animal facilities to laboratories, anaesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Technical writing, thesis/research report writing, structure of thesis, editing and formatting, reference citations, abstracting, plagiarism and paraphrasing, tools for writing good research report.

UNIT – VI

Research reporting - poster presentation, seminar and conference presentation, publishing in journals, copyright.

REFERENCE BOOKS

19. Atiya Khanum Irfan Ali Khan, Biostatistics for Pharmacy, 2nd Edition, 2007, UkaazPublications, Hyderabad.
20. C. George Thomas. Research Methodology and Scientific Writing First edition, 2016, AneBooks Pvt. Ltd.; New Delhi.
21. C. R Kothari. Research Methodology: Methods and Techniques. New Age International

(P)Ltd, Publishers. New Delhi.
22. Mahajan, B.K. Methods in Biostatistics for Medical Students and Research workers, 7thEdition 2008 Jaypee Brothers.
23. Putul Mahanta , Medical Writing: A Guide for Medicos, Educators and Researchers JaypeeBrothers Medical Publishers; First edition (2018).
24. Ranjan Das, Biomedical Research Methodology: Including Biostatistical Applications. 1stEdn. Jaypee Brothers.
25. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 3rd Edition 2011,Sage Publications India Pvt. Ltd., New Delhi.
26. Sharma Suresh. Research Methodology and Biostatistics- A Comprehensive Guide for HealthCare Professionals. 1st Edn. Elsevier India.
27. Sunder Rao. P.S.S and Richard. J. An introduction to Biostatistics: A manual for students inhealth sciences. Prentice-Hall of India Pvt. Ltd Publishers.

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Q P CODE REG NO

MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL REGULATORY AFFAIRS
FIRST SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - I – GOOD REGULATORY PRACTICES (MRA 101T)

Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Write in detail about USGMP with reference to part210 and part 211.
2. Write in detail about USFDA GLP regulations
3. Write in detail about the principles and requirements of GALP

SHORT NOTES (9X5=45)

4. Write briefly about WHO cGMP guidelines
5. Write briefly about concept of ISO
6. Write a note on software evaluation checklist
7. Write a note on stability testing principles
8. Describe the goals of laboratory quality audit
9. Write briefly about cleaning validation
10. Write a note on validation master plan
11. Write briefly about training documentation of GALP
12. Write a note on total quality management

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MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL REGULATORY AFFAIRS
FIRST SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - II – DOCUMENTATION AND REGULATORY WRITING (MRA 102T)

Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. What is product development report (PDR) Discuss the significance of PDR
2. Define CTD and eCTD. Describe the modules of ICH -CTD format with granularity
3. Discuss the Root cause analysis of deviation. Describe the corrective and preventive action.

SHORT NOTES **(9×5=45)**

4. Describe about Batch Manufacturing record and its calculations
5. What is Drug Master file (DMF) Discuss the types of DMFs
6. Outline the contents and organization of dossiers
7. Differentiate Internal, External, second party and external third-party audits.
8. Describe the quality systems requirements of national good distribution practices
9. Discuss the post approval changes (SUPAC) process for an approved drug product
10. Describe the process of post approval labelling changes
11. Discuss the electronic submission process and validating the submission
12. Discuss the Non eCTD electronic submission (NeeS) format and its difference with CTD.

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MODEL QUESTION PAPER
M.PHARM PHARMACEUTICAL REGULATORY AFFAIRS
FIRST SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER – III CLINICAL RESEARCH REGULATIONS (MRA 103T)

Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Explain the responsibilities of sponsors, CRO and investigator in ethical conduct of clinical research
2. Enumerate the application procedure for approval of NDA 505 (b) (1).
3. Explain the principles of ICMR Ethical Guidelines for biomedical research

SHORT NOTES (9×5=45)

4. Write a note on Phase 0 studies
5. Define and explain ethical principles of informed consent process
6. Write a note on role of placebo in clinical trials
7. Explain the clinical trial protocol
8. Write a note on ANDA and its approval procedure
9. Explain regulatory requirements of BA/BE studies
10. Discuss on EU directives 2001
11. Enumerate the Indian GCP guidelines
12. Write a note on 21 CFR part 312 (IND application)

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MODEL QUESTION PAPER

M.PHARM PHARMACEUTICAL REGULATORY AFFAIRS

FIRST SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER – IV - REGULATIONS AND LEGISLATIONS FOR DRUGS &COSMETICS, MEDICAL DEVICES, BIOLOGICALS &HERBALS, AND FOOD &NUTRACEUTICALS IN INDIA AND INTELLECTUAL PROPERTY RIGHTS (MRA 104T)

Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Describe in detail about WHO patent IPR and its types
2. Discuss Indian pharmacopoeial standards BIS and ISO in detail
3. Ethical guidelines for human participants ICMR -DBT

SHORT NOTES (9×5=45)

4. Guidelines for stem cell research
5. Write about the parts of patent
6. DPCO and NPPA
7. CDSCO responsibilities
8. Guidelines for preclinical studies
9. Regulatory requirements for bioequivalence study
10. Guidelines for stem cell research
11. ICH stability requirements
12. BCS classification of drugs

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MODEL QUESTION PAPER
M.PHARM REGULATORY AFFAIRS
SECOND SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER - I – REGULATORY ASPECTS OF DRUGS & COSMETICS (MRA 201T)

Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Discuss in detail the organization and structure of EMA. Also discuss one marketing authorization procedure in EU.
2. Give regulatory requirements for Investigational New Drug (IND) submission, Format & content of IND,content of Investigation Brochure.
3. What are the Legislation and Regulations for manufacture and sale of cosmetics in ASEAN and CIS?

Short notes (9x5=45)

4. What are the regulatory considerations for manufacturing in Japan?
5. Write the full form of the following: a. CFR b. FFDCA DMF c. CIS d. ANDA e. ASEAN
6. What is Drug Master Files (DMF)? Discuss different types of DMFs.
7. Explain the regulatory consideration for packaging and labelling of pharmaceutical in EU.
8. Explain the Pharmaceuticals and Medical Devices Agency (PMDA) and discuss its functions.
9. Write a note on WHO in relation to registration.
10. Explain the relation of Hatch Waxman act with respect to 30 month stay.
11. Discuss the regulation approval process for NDA.
12. Write a role of FDA in various countries in the new drug development.

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MODEL QUESTION PAPER
M.PHARM REGULATORY AFFAIRS
SECOND SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER – II – REGULATORY ASPECTS OF HERBALS AND BIOLOGICALS (MRA 202T)

Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. What are the various requirements and procedures for registering and marketing vaccines in India?
2. Compare the pre-clinical and clinical development considerations for biologicals in USA and European Union.
3. Write in the detail about various data requirements for Pre-clinical and clinical studies in India.

Short notes (9x5=45)

4. Write not on Pharmacovigilance.
5. Labelling and packaging requirements for Blood products for European market
6. Process and requirements for BLA
7. Discuss about format and contents of an IND application.
8. Describe about regulations for quality and safety of herbal products in India.
9. Discuss about laws and regulations on biologics and biosimilars.
10. Write not on Plasma master file.
11. Discuss about stability, safety guidelines in European Union.
12. Describe about GMP requirements for equipment, container and closures.

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MODEL QUESTION PAPER
M.PHARM REGULATORY AFFAIRS
SECOND SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER – III – REGULATORY ASPECTS OF MEDICAL DEVICES (MRA 203T)

Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Explain in detail the validation and verification of Medical devices.
2. Explain the Quality system requirements (21 CFR Part 820) and labeling requirements (21 CFR Part 801) ofmedical devices in US.
3. Discuss the major highlights for the devices and *in vitro* diagnostics as per European Union?

Short notes (9X5=45)

4. Discuss IVD's.
5. Write note on Summary Technical Documents.
6. What is the clinical evaluation and investigation procedure of medical devices in China?
7. What are post marketing surveillance of medical devices?
8. What are the necessary requirements for Premarket Notification 510K Submission for Medical Device?
9. Pre-marketed approval as per US FDA.
10. Give risk-based classification and essential principles of medical devices with examples.
11. Explain the regulatory registration procedure of IVDs in Japan.
12. Explain the adverse event reporting of medical devices.

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MODEL QUESTION PAPER
M.PHARM REGULATORY AFFAIRS
SECOND SEMESTER M. PHARM DEGREE EXAMINATIONS

PAPER – IV – REGULATORY ASPECTS OF FOOD & NEUTRACEUTICALS (MRA 204T)

Answer all questions

Time: 3 hours Maximum Marks: 75

Essays (3x10=30)

1. Discuss the regulations for import of nutraceuticals according to FSSAI.
2. Explain regulatory requirements and its approval procedure for Nutraceuticals, Cosmetics and Biologics in India.
3. What are dietary supplements and medical foods? Giving examples critically explain their role in human body.

Short notes (9X5=45)

4. Mention the critical considerations about good manufacturing practices for nutraceuticals
5. Write the functions of Food Safety and Standards Authority of India (FSSAI).
6. Comment on the chemicals other than vitamins and minerals whose addition to food is prohibited according toEFSA.
7. Discuss the US FDA dietary supplement health and education act.
8. What are dietary fibres? Explain their importance as functional foods.
9. What are medical foods, functional foods and nutraceuticals? Giving examples explain their role in healthcare.
10. Summarize the prohibition orders served under FSSAI Act.
11. Labelling requirements for dietary supplements in USA.
12. Write a note on the RDA for calcium and iron in US.