M.PHARM
PHARMACEUTICAL ANALYSIS

19MPA101T FIRST SEMESTER

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES 4H 4C

Instruction hours/ week: L: 4 T:0 P:0 Marks: Internal: 25 External: 75 Total:100
External Semester Exam: 3Hours

Course Objectives:

- This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs.
- The students will be dealing with instruments like NMR, Mass spectrometer, IR, HPLC, GC etc.
- Acquire skills in selecting the suitable techniques for analysis of drugs
- Validate the instruments used in Pharma industry
- Expand the theoretical knowledge on various instrumental techniques available for analysis of organic substances
- Expertise in various spectroscopic studies

Course Outcome:

After completion of course student will

1. Persuade the theoretical and practical skills of the instruments
2. Analyze various drugs in single and combination dosage forms
3. Acquire skills in selecting the suitable techniques for analysis of drugs
4. Validate the instruments used in Pharma industry
5. Expand the theoretical knowledge on various instrumental techniques available for analysis of organic substances
6. Expertise in various spectroscopic studies

THEORY **60Hrs**

1. a. UV-Visible spectroscopy: **10Hrs**

Introduction, Theory, Laws, Instrumentation 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 vibration frequencies and Applications of IR spectroscopy, Data Interpretation.

c. Spectro flourimetry:

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: 10Hrs**

Quantum numbers and their role in NMR, Principle, Instrumentation, 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: 10Hrs**

Principle, Theory, Instrumentation of Mass Spectroscopy, 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: 10Hrs**

Principle, apparatus, instrumentation, chromatographic 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: 10Hrs**

Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) 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. **Potentiometry: 10Hrs**

Principle, working, Ion selective Electrodes and Application of potentiometry. Thermal Techniques:

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.

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

Reference Books (Latest Editions):

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons,2004.

2. Principles of Instrumental Analysis - Doglas 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, CBS Publishers, 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. DekkerSeries

8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd.,Delhi.

9. Textbook of Pharmaceutical Analysis,KA.Connors, 3rd Edition, John Wiley & Sons,1982

19MPA102T FIRST SEMESTER

ADVANCED PHARMACEUTICAL ANALYSIS 4H 4C

Instruction hours/ week: L: 4T:0P:0 Marks: Internal: 25 External: 75 Total:100
External Semester Exam: 3Hours

Course Objectives:

- This subject deals with the various aspects of Impurity, Impurities in new drug products, in residual solvents, Elemental impurities.
- The student will expertise in Impurity profiling and characterization of degradants,
- This subject deals with Stability testing of phytopharmaceuticals and their protocol preparation.
- It also covers the biological testing of various vaccines and their principle and procedure.
- The subject emphasize on assay and different tests for drug products.
- The subject also provides knowledge regarding immunoassay and techniques involved in immunoassay

Course Outcome:

After completion of the course students will,

1. Develop appropriate analytical skills required for the analytical method development
2. Discover principles of various reagents used in functional group analysis that renders necessary support in research methodology
3. Demonstrates the applications of analytical principles in the practical related problems
4. Design the analysis of impurities in drugs and residual solvents
5. Expertise in stability testing and biological methods of purity determination
6. Acquire skills in identifying the impurities in combinational drugs

THEORY 60Hrs

1. Impurity and stability studies: 10Hrs

Definition, classification of impurities in drug Substance or Active Pharmaceutical Ingredients and quantification of impurities as per ICH guidelines

Impurities in new drug products:

Rationale for the reporting and control of degradation products, reporting degradation products content of Patches, listing of degradation products in specifications, qualification of degradation products

Impurities in residual solvents:

General principles, classification of residual solvents, Analytical procedures, limits of residual solvents, reporting levels of residual solvents

2. Elemental impurities: 10Hrs

Element classification, control of elemental impurities, Potential Sources of elemental Impurities, Identification of Potential Elemental Impurities, analytical procedures, instrumentation & C,H, N and S analysis

Stability testing protocols:

Selection of batches, container orientation, test parameters, sampling frequency, specification, storage conditions, recording of results, concept of stability, commitment etc. Important mechanistic and stability related information provided by results of study of factors like temperature, pH, buffering species ionic strength and dielectric constant etc. on the reaction rates. With practical considerations.

3. Impurity profiling and degradants characterization: **10 Hrs**

Method development, Stability studies and concepts of validation accelerated stability testing & shelf life calculation, WHO and ICH stability testing guidelines, Stability zones, steps in development, practical considerations. Basics of impurity profiling and degradant characterization with special emphasis. Photo stability testing guidelines, ICH stability guidelines for biological products

4 .Stability testing of Phytopharmaceuticals: 10Hrs

Regulatory requirements, protocols, HPTLC/HPLC finger printing, interactions and complexity.

5. Biological tests and assays of the following: 10Hrs

A. Adsorbed Tetanus vaccine
B. Adsorbed Diphtheria vaccine
C. Human anti haemophilic vaccine
D. Rabies vaccine
E. Tetanus Antitoxin
F. Tetanus ntiserum
G. Oxytocin
H. Heparin sodiumIP
I. Antivenom. PCR, PCR studies for generegulation, instrumentation (Principle and Procedures)

6. Immunoassays(IA) 10Hrs

Basic principles, Production of antibodies, Separation of bound and unbound drug, Radioimmunoassay, Optical IA, Enzyme IA, Fluoro IA, Luminiscence IA, Quantification and applications of IA.

Reference Books (Latest Editions):

1. Vogel's textbook of quantitative chemical analysis - Jeffery J Bassett, J.Mendham, R. C. Denney,5th edition, ELBS,1991.

2. Practical Pharmaceutical Chemistry - Beckett and Stenlake, Vol II, 4thEdition, CBS publishers, NewDelhi, 1997.

3. Textbook of Pharmaceutical Analysis - K A Connors, 3rdEdition, John Wiley & Sons,1982.

4. Pharmaceutical Analysis - Higuchi, Brochmman and Hassen, 2nd Edition,Wiley – Interscience Publication,1961.

5. Quantitative Analysis of Drugs in Pharmaceutical formulation – P D Sethi,3rdEdition, CBSPublishers New Delhi, 1997.

6. Pharmaceutical Analysis- Modern methods - J W Munson – Part B,Volume11, Marcel DekkerSeries.

7. The Quantitative analysis of Drugs - D C Carratt, 3rdedition, CBSPublishers, NewDelhi,1964.

8. Indian Pharmacopoeia Vol I , II & III 2007, 2010,2014.

9. Methods of sampling and microbiological examination of water, firstrevision,BIS

10. Practical HPLC method development – Snyder, Kirkland, Glajch, 2ndedition, John Wiley &Sons.

11. Analytical Profiles of drug substances – Klaus Florey, Volume 1 – 20,Elsevier,2005

12. Analytical Profiles of drug substances and Excipients – Harry G Brittan,Volume 21 – 30, Elsevier,2005.

13. The analysis of drugs in biological fluids - Joseph Chamberlain, 2ndedition, CRC press,London.

14. ICH Guidelines for impurity profiles and stability studies.

19MPA103T FIRST SEMESTER

PHARMACEUTICAL VALIDATION 4H 4C

Instruction hours/ week: L:4T:0P:0 Marks: Internal: 25 External: 75 Total:100
External Semester Exam: 3Hours

Course Objectives:

- The main purpose of the subject is to understand about validation and how it can be applied to industry
- The subject aims to improve the quality of the products.
- The subject covers the complete information about validation, types, methodology and application.
- The student will receive a deep knowledge on intellectual property rights
- The subject provides an advanced knowledge on patents and its specifications
- Different techniques like TOT, IPP and social responsibilities to be followed will be discussed.

Course Outcome:

Upon completion of the subject student will

1. Explain the aspect of validation
2. Carry out validation of manufacturing processes
3. Apply the knowledge of validation to instruments and equipment's
4. Validate the manufacturing facilities
5. Revise the importance of patent and intellectual property rights.
6. Construct method validation as per ICH guidelines

THEORY **60Hrs**

12Hrs

1. Introduction: Definition of Qualification and Validation, Advantage of Validation, Streamlining of Qualification & Validation process and Validation Master Plan. 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), Qualification of Manufacturing Equipments, Qualification of Analytical Instruments and Laboratory equipments.

12Hrs

2. Qualification of analytical instruments: Electronic balance, pH meter, UV-Visible spectrophotometer, FTIR, GC, HPLC, HPTLC Qualification of Glassware: Volumetric flask, pipette, Measuring cylinder, beakers and burette.

12Hrs

3. Validation of Utility systems: Pharmaceutical Water System & pure steam, HVAC system, Compressed air and nitrogen. Cleaning Validation: Cleaning Validation - Cleaning Method development, Validation and validation of analytical method used in cleaning. Cleaning of Equipment, Cleaning of Facilities. Cleaning n place (CIP).

12Hrs

4. Analytical method validation: General principles, Validation of analytical method as per ICH guidelines and USP. Computerized system validation: Electronic records and digital significance-21 CFR part 11 and GAMP5.

. **12Hrs**

5. General Principles of Intellectual Property: 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 applications; 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

Reference Books (Latest Editions):

1. B. T. Loftus & R. A. Nash, "Pharmaceutical Process Validation", Drugs and Pharm Sci. Series, Vol. 129, 3rdEd., Marcel Dekker Inc.,N.Y.
2. The Theory & Practice of Industrial Pharmacy, 3rdedition, Leon Lachman, Herbert A. Lieberman, Joseph. L. Karig, Varghese PublishingHouse,Bombay.
3. Validation Master plan by Terveeks or Deeks, Davis Harwood International publishing.
4. Validation of Aseptic Pharmaceutical Processes, 2ndEdition, by Carleton &Agalloco, (MarcelDekker).
5. Michael Levin, Pharmaceutical Process Scale-Up‖, Drugs and Pharm. Sci.Series, Vol. 157,2ndEd., Marcel Dekker Inc.,N.Y.
6. Validation Standard Operating Procedures: A Step by Step Guide for Achieving Compliance inthe Pharmaceutical, Medical Device, and Biotech Industries, Syed ImtiazHaider
7. Pharmaceutical Equipment Validation: The Ultimate Qualification Handbook, Phillip A. Cloud, InterpharmPress
8. Validation of Pharmaceutical Processes: Sterile Products, Frederick J.Carlton (Ed.) and JamesAgalloco

(Ed.), Marcel Dekker, 2nd Ed.

9. Analytical Method validation and Instrument Performance Verification by Churg Chan, HeimanLam, Y.C. Lee, Yue. Zhang, Wiley Inter Science.

19MPA104T FIRST SEMESTER

FOOD ANALYSIS **4H** **4C**

Instruction hours/ week: L: 4T:0P:0 Marks: Internal: 25 External: 75 Total:100

External Semester Exam: 3Hours

Course Objectives:

- This course is designed to impart knowledge on analysis of food constituents
- This course is designed to impart knowledge on analysis of finished food products.
- The course includes application of instrumental analysis in the determination of pesticides in variety of food products.
- The subject deals with legislation regulations associated with food products
- The subject covers a wide knowledge on analytical techniques to be followed in the determination of food regulations
- The subject also emphasize on analysis of fermented products like wine, spirits etc

Course Outcome:

At completion of this course student will

1. Understand various analytical techniques in the determination of food constituents
2. Devise various analytical techniques in the determination of food additives
3. Create various analytical techniques in the determination of finished food products
4. Demonstrate various analytical techniques in the determination of pesticides in food
5. Review various analytical techniques in the determination of food regulations
6. Recognize various analytical techniques in the determination of food legislations

THEORY **60Hrs**

12Hrs

1**.** Carbohydrates – Chemistry & classification and properties of food carbohydrates, General methods of analysis of food carbohydrates, Changes in food carbohydrates during processing, Digestion, absorption and metabolism of carbohydrates, Dietary fibre, crude fibre and application of food carbohydrates.

Proteins - Chemistry and classification of amino acids and proteins, Physico- Chemical properties of protein and their structure, general methods of analysis of proteins and amino acids, Digestion, absorption and metabolism of proteins.

12Hrs

2.a. Lipids – Classification, general methods of analysis, refining of fats and oils; hydrogenation of vegetable oils, Determination of adulteration in fats and oils, Various methods used for measurement of spoilage of fats and fatty foods.

b. Vitamins – classification of vitamins, methods of analysis of vitamins, Principles of microbial assay and physiological significance of vitamins of B-series.

12Hrs

3. Food additives – Introduction, analysis of Preservatives, antioxidants, artificial sweeteners, flavors, flavor enhancers, stabilizers, thickening and jelling agents.

   Pigments and synthetic dyes- Natural pigments their occurrence and characteristic properties, permitted synthetic Dyes, Non-Permitted synthetic dyes used by industries, Method of detection of natural, permitted and non-permitted dyes

12Hrs

4. General Analytical methods for milk, milk constituents and milk products like ice cream, milk powder, butter, margarine, cheese including adulterants and contaminants of milk.

   Analysis of fermentation products like wine, spirits, beer and vinegar.

12Hrs

5. Pesticide analysis-Effects of pesticides insects on various food, use of pesticides in agriculture, pesticide cycle, organophosphorus and organo chlorine pesticides analysis, determination of pesticide residues in grain, fruits, vegetables, milk and milk products.

   Legislation regulations of food products with special emphasis on BIS, Agmark and US-FDA

Reference Books (Latest Editions):

1. The chemical analysis of foods–David Pearson,Seventh edition,Churchill Livingstone,Edinburgh London,1976
2. Introduction to the Chemical analysis of foods–S.Nielsen,Jones&Bartlettpublishers,BostonLondon,1994.
3. Official methods of analysis of AOAC International, sixth edition, VolumeI&II, 1997.
4. Analysis of Food constituents–Multon, Wiley VCH.
5. Dr.William Horwitz, Official methods of analysis of AOAC International,18 th edition,2005.

19MPA105P FIRST SEMESTER

PHARMACEUTICAL ANALYSIS PRACTICAL I 12H 6C

Instruction hours/ week: L: 0T:0P:12 Marks: Internal: 50 External: 100 Total:150

External Semester Exam: 3Hours

Course Objectives:

- To estimate the samples using analytical instruments.
- To perform assay of official drug samples using analytical intruments
- To determine the impurity profile of drugs.
- To separate the mixtures of sample using chromatographic techniques.
- To demonstrate HPLC.
- To demonstrate gas chromatography.

Course Outcome:

At completion of this course student will

1. Demonstrate the analysis of pharmacopieal compounds and simultaneous estimation by UV-VIS
2. Acquire skills in selecting the suitable techniques for analysis of drugs
3. Expertise in stability testing and biological methods of purity determination
4. Validate impurity profiling of drugs
5. Compare and contrast various methods of analysis and their outcomes
6. Demonstrate calibration of various glassware and instruments used in pharma industry

CONTENTS:

1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer
2. Simultaneous estimation of multicomponent 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
7. Assay of official compounds by different titrations
8. Assay of official compounds by instrumental techniques.
9. Quantitative determination of hydroxyl group.

10. Quantitative determination of amino group
11. Colorimetric determination of drugs by using different reagents
12. Impurity profiling of drugs
13. Calibration of glassware's
14. Calibration of pH meter
15. Calibration of UV-Visible spectrophotometer
16. Calibration of FTIR spectrophotometer
17. Calibration of GC any instrument
18. Calibration of HPLC instrument
19. Cleaning validation of anyone equipment
20. Determination of total reducing sugar
21. Determination of proteins
22. Determination of saponification value, Iodine value, Peroxide value, Acid value in food products
23. Determination of fat content and rancidity in food products
24. Analysis of natural and synthetic colors in food
25. Determination of preservatives in food
26. Determination of pesticide residue in food products
27. Analysis of vitamin content in food product
28. Determination of density and specific gravity of foods
29. Determination of food additive

Reference Books (Latest Editions):

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons,2004.

2. Principles of Instrumental Analysis - Doglas 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, CBS Publishers, 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. DekkerSeries

8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd.,Delhi.

9. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley & Sons,1982

19MPA201T SECOND SEMESTER

ADVANCED INSTRUMENTAL ANALYSIS **4H 4C**

Instruction hours/ week: L: 4T:0P:0 Marks: Internal: 25 External: 75 Total:100

External Semester Exam: 3Hours

Course Objectives:

- This subject deals with various hyphenated analytical instrumental techniques for identification, characterization and quantification of drugs.
- Instruments dealt are LC-MS, GC-MS, and hyphenated techniques.
- The course provides an elaborate knowledge on HPLC in the field of nanotechnology and approaches for advancement in enantiomeric separations.
- The course offers advanced biochromatographical techniques, its approaches and derivatization.
- The subject includes hyphenation techniques in LC-MS and DART MS analysis
- 13C NMR, 1-D and 2-D NMR, NOESY and COSY techniques were also included in the study

Course Outcome:

After completion of course student will,

1. Interpret NMR, Mass and IR spectra of various organic compounds
2. Demonstrate theoretical and practical skills of the hyphenated instruments
3. Undergo Identification of organic compounds
4. Acquire Practical aspects and troubleshooting techniques for HPLC techniques
5. Expertise in controlling the parameters that affect drug manufacturing
6. Acquire Practical aspects and troubleshooting techniques for GC techniques

THEORY **60Hrs**

12Hrs

1.HPLC: Principle, instrumentation, pharmaceutical applications, peak shapes, capacity factor, selectivity, plate number, plate height, resolution, band broadening, pumps, injector, detectors, columns, column problems, gradient HPLC, HPLC solvents, trouble shooting, sample preparation, method development, New developments in HPLC-role and principles of ultra, nanoliquid chromatography in pharmaceutical analysis. Immobilized polysaccharide CSP's: Advancement in enantiomeric separations, revised phase Chiral method

development and HILIC approaches. HPLC in Chiral analysis of pharmaceuticals. Preparative HPLC, practical aspects of preparative HPLC. **12Hrs**

2. **Biochromatography:** Size exclusion chromatography, ion exchange chromatography, ion pair chromatography, affinity chromatography general principles, stationary phases and mobile phases. Gas chromatography: Principles, instrumentation, derivatization, head space sampling, columns for GC, detectors, quantification. High performance Thin Layer chromatography: Principles, instrumentation, pharmaceutical applications. **12Hrs**

3. **Super critical fluid chromatography**: **Principles, instrumentation, pharmaceutical applications.**

Capillary electrophoresis: Overview of CE in pharmaceutical analysis, basic configuration, CE characteristics, principles of CE, methods and modes of CE. General considerations and method development in CE, Crown ethers as buffer additives in capillary electrophoresis.CE-MS hyphenation. **12Hrs**

4. **Mass spectrometry:** Principle, theory, instrumentation of mass spectrometry, different types of ionization like electron impact, chemical, field, FAB and MALD, APCI, ESI, APPI mass fragmentation and its rules, meta stable ions, isotopic peaks and applications of mass spectrometry. LC-MS hyphenation and DART MS analysis. Mass analysers (Quadrpole, Time of flight,FT-ICR, ion trap and Orbitrap) instruments. MS/MS systems (Tandem: QqQ, TOF-TOF;Q-IT, Q-TOF,LTQ-FT,LTQ-Orbitrap. **12Hrs**

5. **NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, 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 with reference to 13CNMR:Spin spin and spin lattice relaxation phenomenon. 13C NMR, 1-D and 2-D NMR, NOESY and COSY techniques, Interpretation and Applications of NMR spectroscopy.LC-NMR hyphenations.

Reference Books (Latest Editions):

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, john Wiley & Sons,2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler,TimothyA. Nieman, 5th edition, Eastern press, Bangalore,1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Organic Spectroscopy - William Kemp, 3rd edition, ELBS,1991.
5. Quantitative analysis of Pharmaceutical formulations by HPTLC- PD Sethi, CBS Publishers , New Delhi.
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, Volume 11, MarcelDekker Series.
8. Organic Spectroscopy by Donald L. Paviya, 5th Edition.

19MPA202T SECOND SEMESTER

MODERN BIO-ANALYTICAL TECHNIQUES 4H 4C

Instruction hours/ week: L:4T:0P:0 Marks: Internal: 25 External: 75 Total:100

External Semester Exam: 3Hours

Course Objectives:

- This subject is designed to provide detailed knowledge about the importance of analysis of drugs in biological matrices.
- The subjects deals with different pharmacokinetic and pharmacodynamic parameters
- The subject emphasize on bioavailability and bioequivalence studies
- The course provides a detailed advancement on toxicokinetic studies and its importance in preclinical studies.
- The course outlines on cell culture techniques and its applications including MTT.
- The course provides knowledge on LC-MS in bioactivity screening and proteomics

Course Outcome:

Upon completion of the course, the student will

1. Undergo Extraction of drugs from biological samples
2. Demonstrate separation of drugs from biological samples using different techniques
3. Interpret the guidelines for BA/BE studies
4. Persuade a deep knowledge on BCS classification system and its applications in new drug discovery process
5. Understand various pharmacokinetics and Pharmacodynamic parameters affecting drug efficacy
6. Acquire knowledge on LC-MS in bioactivity screening and proteomics.

THEORY **60Hrs**

12Hrs

1. Extraction of drugs and metabolites from biological matrices: General need, principle and procedure involved in the Bioanalytical methods such as Protein precipitation, Liquid -Liquid extraction and Solid phase extraction and other novel sample preparationapproach.

   Bioanalytical method validation: USFDA and EMEA guidelines.

   12 hrs

2. Biopharmaceutical Consideration: Introduction, Biopharmaceutical Factors Affecting Drug Bioavailability, In Vitro: Dissolution and Drug Release Testing, Alternative Methods of Dissolution

Testing Transport models, Biopharmaceutics Classification System. Solubility: Experimental methods. Permeability*: In-vitro*, *in-situ* and *In-vivo* methods.

12 hrs

3. Pharmacokinetics and Toxicokinetics: Basic consideration, Drug interaction (PK-PD interactions)

   The effect of protein-binding interactions, The effect of tissue-binding interactions, Cytochrome P450- based drug interactions, Drug interactions linked to transporters. Microsomal assays Toxicokinetics- Toxicokinetic evaluation in preclinical studies, Importance and applications of toxicokinetic studies.LC-MS in bioactivity screening and proteomics.

12 hrs

4. Cell culture techniques Basic equipments used in cell culture lab. Cell culture media, various types of cell culture, general procedure for cell cultures; isolation of cells, subculture, cryopreservation, characterization of cells and their applications. Principles and applications of cell viability assays (MTT assays), Principles and applications of flow cytometry.

12 hrs

5. Metabolite identification: In-vitro / in-vivo approaches, protocols and sample preparation. Microsomal approaches (Rat liver microsomes (RLM) and Human liver microsomes (HLM) in Met –ID. Regulatory perspectives. In-vitro assay of drug metabolites & drug metabolizing enzymes.

   Drug Product Performance, In Vivo: Bioavailability and Bioequivalence: Drug Product Performance, Purpose of Bioavailability Studies, Relative and Absolute Availability. Methods for Assessing Bioavailability, Bioequivalence Studies, Design and Evaluation of Bioequivalence Studies, Study Designs, Crossover Study Designs, Generic Biologics (Biosimilar Drug Products), Clinical Significance of Bioequivalence Studies.

Reference Books (Latest Editions):

1. Analysis of drugs in Biological fluids - Joseph Chamberlain, 2nd Edition.CRC Press, Newyork.1995.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler,TimothyA. Nieman, 5th edition, Eastern press, Bangalore,1998.
3. Pharmaceutical Analysis - Higuchi, Brochmman and Hassen, 2nd Edition,Wiley – Interscience Publications, 1961.
4. Pharmaceutical Analysis- Modern methods – Part B - J W Munson,Volume 11, Marcel DekkerSeries
5. Practical HPLC method Development – Snyder, Kirkland, Glaich, 2nd Edition, John Wiley & Sons, New Jercy.USA.
6. Chromatographic Analysis of Pharmaceuticals – John A Adamovics, 2nd Edition, Marcel Dekker,Newyork,

USA. 1997.

7. Chromatographic methods in clinical chemistry & Toxicology – Roger L Bertholf, Ruth E Winecker, John Wiley & Sons, New Jercy, USA.2007.

8. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol.69, Marcel Dekker Series,1995.

9. Good laboratory Practice Regulations – Allen F. Hirsch, Volume 38, Marcel Dekker Series, 1989.

10. ICH, USFDA & CDSCO Guidelines.

11. Palmer

19MPA203T SECOND SEMESTER

QUALITY CONTROL AND QUALITY ASSURANCE 4H 4C

Instruction hours/ week: L: 0T:0P:3 Marks: Internal: 25 External: 75 Total:100

External Semester Exam: 3Hours

Course Objectives:

- This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries.
- It covers the important aspects like cGMP,QCtests ,documentation ,quality certifications ,GLP and regulatory affairs.
- Procedures to ensure confidentiality of inventory and source category information, when required are explained
- Frequency of QA/QC checks on different parts of the inventory was dealt in the subject
- The subject covers about glp responsibilities nad regulatory affairs
- The subject deals with SOPs or standard operating procedures

Course Outcome:

At the completion of this subject it is expected that the student will,

1. Understand the cGMP aspects in a pharmaceutical industry
2. Appreciate the importance of documentation
3. Understand the scope of quality certifications applicable to Pharmaceutical industries
4. Recognize the responsibilities of QA & QC departments
5. Acquire knowledge on GLP and regulatory Affairs
6. Interpret CPCSEA guidelines

THEORY 60hrs

1. 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. **12Hrs**

2. cGMP guidelines according to schedule M, USFDA (inclusive of CDER and CBER) Pharmaceutical

Inspection Convention (PIC), WHO and EMEA covering: 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. **12Hrs**

3. Analysis of raw materials, finished products, packaging materials, 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 formulation in Pharma industry according to Indian, US and British pharmacopoeias: tablets, capsules, ointments,suppositories, creams, parenterals, ophthalmic and surgical products (How to refer pharmacopoeiasQualitycontrol test for containers, closures and secondary packing materials.

12 Hrs

4. Documentation in pharmaceutical industry: 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 Formula Record, Batch Formula Record, Quality audit plan and reports. Specification and test procedures, Protocols and reports. Distribution records. Electronic data. **12Hrs**

5. Manufacturing operations and controls: Sanitation of manufacturing premises, mix-ups and cross contamination, processing of intermediates and bulk products, packaging operations, IPQC, 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. **12Hrs**

Reference Books (Latest Editions):

1. Quality Assurance Guide by organization of Pharmaceutical Procedures of India, 3rd revised edition, olume I & II, Mumbai,1996.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69, Marcel Dekker Series,1995.
3. QualityAssuranceofPharmaceuticals-AcompediumofGuidelinesandRelatedmaterialsVolI&II,2nd edition, WHO Publications,1999.

4. How to Practice GMP's – P P 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, 3rdedition, WHO, Geneva,2005.

6. Good laboratory Practice Regulations – Allen F. Hirsch, Volume 38, Marcel Dekker Series, 1989.7. ICH guidelines

7. ISO 9000 and total quality management114

8. The drugs and cosmetics act 1940 – Deshpande, Nilesh Gandhi, 4thedition, SusmitPublishers,2006.

9. QA Manual – D.H. Shah, 1stedition, Business Horizons,2000.

10. Good Manufacturing Practices for Pharmaceuticals a plan for total quality control – Sidney H. Willig,Vol. 52, 3rdedition, Marcel Dekker Series. 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.

11. Sarker DK. Quality Systems and Controls for Pharmaceuticals. John Wiley & Sons;2008.

19MPA204T SECOND SEMESTER

HERBAL AND COSMETIC ANALYSIS 4H 4C

Instruction hours/ week: L: 4T:0P:0 Marks: Internal: 25 External: 75 Total:100

External Semester Exam: 3Hours

Course Objectives:

- This course is designed to impart knowledge on analysis of herbal products.
- Regulatory requirements, herbal drug interaction with monographs were explained.
- Performance evaluation of cosmetic products is included for the better understanding of the equipments used in cosmetic industries for the purpose.
- Describe guidelines for cGMP, GAP, GMP and GLP for quality assurance of herbal drugs in industry
- Describe guidelines for quality control of herbal drugs and evaluation of safety and efficacy of herbal medicines.
- The subject deals with herbal drug interactions

Course Outcome:

At completion of this course student will

1.Determine the herbal remedies and regulations

2.Demonstrate the analysis of natural products and monographs

3.Interpret Herbal drug-drug interaction

4.Exploit the principles of performance evaluation of cosmetic products.

5. Understand the pre requisites to be followed in the preparation of the herbal monographs

6. Express the Indian Standard specification laid down for sampling and testing of various cosmetics

THEORY 60Hrs

1. Herbal remedies- Toxicity and Regulations: Herbals vs Conventional drugs, Efficacy of herbal medicine products, Validation of Herbal Therapies, Pharmacodynamic and Pharmacokinetic issues. Herbal drug standardization: WHO andAYUSHguidelines. **12Hrs**

2 .Adulteration and Deterioration: Introduction, types of adulteration/substitution of herbal drugs, Causes and

Measure of adulteration, Sampling Procedures, Determination of Foreign Matter, DNA Finger printing techniques in identification of drugs of natural origin, heavy metals, pesticide residues, phototoxin and microbial contamination in herbal formulations. Regulatory requirements for setting herbal drug industry: Global marketing management, Indian and international patent law as applicable herbal drugs and natural products anditsprotocol. **12Hrs**

3. Testing of natural products and drugs: Effect of herbal medicine on clinical laboratory testing, Adulterant Screening using modern analytical instruments, Regulation and dispensing of herbal drugs, Stability testing of natural products,protocol.

Monographs of Herbal drugs: Study of monographs of herbal drugs and comparative study in IP, USP, Ayurvedic Pharmacopoeia, American herbal Pharmacopoeia, British herbal Pharmacopoeia, Siddha and Unani Pharmacopoeia, WHO guidelines in quality assessment ofherbaldrugs. **12Hrs**

4. Herbal drug-drug interaction: WHO and AYUSH guidelines for safety monitoring of natural medicine, Spontaneous reporting schemes for bio drug adverse reactions, bio drug-drug and bio drug-food interactions with suitable examples. Challenges in monitoring the safety ofherbalmedicines. **12Hrs**

5. Evaluation of cosmetic products: Determination of acid value, ester value, saponification value, iodine value, peroxide value, rancidity, moisture, ash, volatile matter, heavy metals, fineness of powder, density, viscosity of cosmetic raw materials and finished products. Study of quality of raw materials and general methods of analysis of raw material used in cosmetic manufacture as perBIS.

Indian Standard specification laid down for sampling and testing of various cosmetics in finished forms such as baby care products, skin care products, dental products, personal hygiene preparations, lips sticks. Hair products and skin creams by the BureauIndianStandards. **12Hrs**

Reference Books (Latest Editions):

1. Pharmacognosy by Trease andEvans
2. Pharmacognosy by Kokate, Purohit and Gokhale
3. Quality Control Methods for Medicinal Plant, WHO,Geneva
4. Pharmacognosy &Pharmacobiotechnology by AshutoshKar
5. Essential of Pharmacognosy byDr.S.H.Ansari
6. Cosmetics – Formulation, Manufacturing and Quality Control, P.P.Sharma, 4th edition, Vandana Publications Pvt. Ltd.,Delhi
7. Indian Standard specification, for raw materials, BIS, NewDelhi.

8. Indian Standard specification for 28 finished cosmetics BIS, NewDelhi

9. Harry's Cosmeticology 8th edition

10. Suppliers catalogue on specialized cosmeticexcipients

11. Wilkinson, Moore, seventh edition, George Godwin. Poucher's Perfumes, Cosmetics andSoaps

12. Hilda Butler, 10th Edition, Kluwer Academic Publishers. Handbook of Cosmetic Science and Technology, 3rd Edition

19MPA205P SECOND SEMESTER

PHARMACEUTICAL ANALYSIS PRACTICAL II 12H 6C

Instruction hours/ week: L: 0 T:0 P:12 Marks: Internal: 50 External:100 Total:150

External Semester Exam: 3 Hours

Course Objectives:

- To estimate the samples using analytical instruments.
- To perform the interpretation of organic compound by ftir, nmr, ms etc
- To determine the impurity profile of drugs.
- To separate the mixtures of sample using chromatographic techniques.
- To demonstrate the protocol preparation and performance of bioanalytical method validation
- To demonstrate cosmetic analysis.

Course Outcome:

At completion of this course student will

1. Demonstrate the interpretation of various organic compounds by FT-IR
2. Demonstrate the interpretation of various organic compounds by NMR
3. Demonstrate the interpretation of various organic compounds by mass spectroscopy
4. Interpret Protocol preparation and performance of analytical/ Bioanalytical method validation
5. Formulate cosmetics and carry out its evaluation
6. Appreciate the importance of documentation by preparing master formula record, batch manufacturing records etc.

CONTENTS :

1. Comparison of absorption spectra by UV and Wood ward – Fiesure rule
2. Interpretation of organic compounds by FT-IR
3. Interpretation of organic compounds by NMR
4. Interpretation of organic compounds by MS
5. Determination of purity by DSC in pharmaceuticals
6. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra
7. Bio molecules separation utilizing various sample preparation techniques and Quantitative analysis of components by gel electrophoresis.
8. Bio molecules separation utilizing various sample preparation techniques and Quantitative analysis of

components by HPLC techniques.

9. Isolation of analgesics from biological fluids (Blood serum and urine).
10. Protocol preparation and performance of analytical/ Bioanalytical method validation.
11. Protocol preparation for the conduct of BA/BE studies according to guidelines.
12. In process and finished product quality control tests for tablets, capsules, parenterals and creams
13. Quality control tests for Primary and secondary packing materials
14. Assay of raw materials as per official monographs
15. Testing of related and foreign substances in drugs and raw materials
16. Preparation of Master Formula Record.
17. Preparation of Batch Manufacturing Record.
18. Quantitative analysis of rancidity in lipsticks and hair oil
19. Determination of aryl amine content and Developer in hair dye
20. Determination of foam height and SLS content of Shampoo.
21. Determination of total fatty matter in creams (Soap, skin and hair creams)
22. Determination of acid value and Saponification value.
23. Determination of calcium thioglycolate in depilatories

Reference Books (Latest Editions):

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons,2004.

2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5thedition, Eastern press, Bangalore,1998.

3. Instrumental methods of analysis – Willards, 7thedition, CBS publishers.

4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4thedition, CBS Publishers, New Delhi,1997.

5.Organic Spectroscopy - William Kemp, 3rdedition, ELBS,1991.

6.Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rdEdition, CBS Publishers, New Delhi,1997.

7. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. DekkerSeries

8. Spectroscopy of Organic Compounds, 2ndedn., P.S/Kalsi, Wiley estern Ltd.,Delhi.

9. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley & Sons,1982