



SYLLABUS

Course Title	INSTRUMENTAL TECHNIQUES FOR CHEMICAL ANALYSIS	
Course Code	MAC302	
Course Credit	Lecture	: 04
	Tutorial	: 00
	Practical	: 00
	Total	: 04
Detailed Syllabus:		
Sr. No.	Name of chapter & Details	Session Allotted
SECTION-I		
1	Thermal Analysis: Introduction and classification, TGA, DTA and DSC: principle, theory and instrumentation, Factors affecting and applications of thermal Analysis Thermometric titrations.	10
2	Electro and Gel Permeation Chromatography: Principle, theory, instrumentation and applications. electrophoresis, reverse osmosis, electro dialysis, and capillary electrophoresis,	10
3	Automated Methods of Chemical Analysis: Introduction, difference among automatic and automated instruments, merits and demerits of automation. Flow injection analysis: Principle, instrumentation and applications. Elemental analyzer: Principle, instrumentation and applications.	10
SECTION-II		
4	Diffraction Techniques: X-ray, Neutron and Electron diffractions Principle and laws of crystallography. Types of X-rays. Reciprocal lattice concept and diffraction conditions. Determination of lattice type and unit cell dimensions Bragg's law, production and detection of X-ray, Diffraction methods and identification of crystals. Structure factor and intensity calculation. Problems.	10

5	Atomic Absorption Spectroscopy: Principles, Instrumentation, Radiation sources, Spectrometer, Background absorption and background correction, Background correction techniques in LS AAS, Application of AAS in chemical analysis.	10
6	Radiochemical Methods: Introduction, radioactive Nuclides, Instrumentation, Neutron activation methods, Isotope dilution methods.	10

Instructional Method and Pedagogy:

1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
3. Surprise tests/Quizzes/Tutorials will be conducted.
4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
5. Minimum ten experiments shall be there in the laboratory related to course contents.

Students Learning Outcomes:

At the end of the course the students will be able to:

- **Differentiate** the advance methods of thermal analysis.
- **Draw** Millar indices for given data.
- **Identify** the application of various diffraction techniques.
- **Operate** powder-X software to extract the information from data.
- **Develop** skill for background correction in AAS.
- **Imitate** instrumentation diagram with proper sequence.
- **Identify** the applications of radioactive materials in chemical analysis.

Reference Books:

1. G.D. Christian. Analytical chemistry. Wiley publication. 7th Edition.
2. Willard, Hobart H.; Merritt, Lynne L., Jr.; Dean, John A. Instrumental methods of chemical analysis. Chemical Education. 1st Edition.
3. L. Barrtal .ELBS Textbook of quantitative chemical analysis. Vogel's. Fifth edition.
4. Gurdeep R. Chatwal, sham K. Anand. Instrumental Methods of chemical analysis. Himalayas publication. First Edition.
5. G.W. Ewing, Instrumental chemical analysis 5th edition. Mc Graw Hill Books Co. New York.
6. H.A. strobe chemical instrumental A schematic Approach 2nd Edition, Addison Wesley, Reading mass.
7. Instrumental Methods of chemical analysis by B.K. Sharma.



SYLLABUS

Course Title	CHEMICAL ANALYSIS IN AGRO, FOOD AND PHARMACEUTICAL INDUSTRIES	
Course Code	MAC303	
Course Credit	Lecture	: 04
	Tutorial	: 00
	Practical	: 03
	Total	: 07
Detailed Syllabus:		
Sr. No.	Name of chapter & Details	Session Allotted
SECTION-I		
1	Food Analysis: Food adulteration – common adulteration in food, contamination of food stuffs, Pesticide analysis in food products, Analysis of milk products: Theory of the analysis of milk, butter and other diary items. Analysis of fats and oils, Iodine value, acid value and saponification value, and their significances.	10
2	Pharmaceutical Analysis: 1. Pharmacopeias at a glance Physical tests 1. Disintegration tests, Dissolution tests (tablets, capsules). Chemical Tests and Assays: Limit test, characteristics of limit tests specificity sensitivity, Loss on drying (NaCl), loss on ignition (ZnO), limit test for lead, arsenic and chloride, moisture determination by KFR titration method	10
3	Analysis of Fertilizers: Sampling and sample preparation, analysis of nitrogen, phosphorus and potassium. Nitrogen: urea nitrogen, total Kjeldahl nitrogen methods, Ammonia nitrogen. Phosphorus: total phosphorus, available and non-available, alkalimetric ammonium molybdophosphate method. Potassium: potassium by sodium tetraphenyl borate method.	10
SECTION-II		
4	Pesticides and Insecticides Analysis: Introduction and history, classification of pesticides and insecticides, formulation and analysis of pesticides and insecticides.	12

5	<p>Forensic Analysis: Special features of Forensic analysis, sampling, sample storage, sample dissolution, classification of poisons, Lethal dose, significance of LD50 and LC50. Identification and Analysis in the suspects: Poisonous elements viz As, Pb, and Hg., Gun powder Residues, Poisoning due to cyanide, dioxines & Physiological effects of natural poisons such as ColChicine, Morphine, Nicotinoids.</p> <p>Analysis of Miscellaneous Materials Principles of estimation of biological fluids. Estimation of hemoglobin, cholesterol and blood sugar (clinical and enzyme assays). Analysis of Alcoholic Beverages. Determination of quality parameters such as original extract, alcohol, extract, CO₂, O₂, pH value, carbohydrate.</p>	16
List of Practicals (3 Hours/Week):		
<ol style="list-style-type: none"> 1. Determination of active content of Endosulphan 2. Determination of active content of Dichlorovos 3. Determination of active content of Phosphamidone 4. Determination of Aspirin 5. Determination of Isoniazide 6. Determination of Antacid 7. Determination of Cephalexin 8. Determination of Calcium Gluconate 9. Determination of Salicylic Acid 10. Determination of Acid Value 		
Instructional Method and Pedagogy:		
<ol style="list-style-type: none"> 1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc. 2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. 3. Surprise tests/Quizzes/Tutorials will be conducted. 4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures. 5. Minimum ten experiments shall be there in the laboratory related to course contents. 		
Students Learning Outcomes:		
<p>At the end of the course the students will be able to:</p> <ul style="list-style-type: none"> ▪ Know the active components in a drug. ▪ Pesticide analysis from food sample. ▪ Understand the importance of forensic analysis microbial assays. 		
Reference Books:		

1. Vogel's textbook of Quantitative Chemical Analysis, 5th Edition, G.H. Jeffery, J, Bassett, J, Mendham and R.C. Denney, Longman Scientific & Technical, UK, 1989.
2. Official Method of Analysis, 15th Edition, 1990, Kenneth Helrich. Association of Official Analytical Chemists Inc, Virginia, USA.
3. Indian Pharmacopeia, Vol 1, 2007, The Indian Pharmacopoeia Commission, Ghaziabad.
4. The International Pharmacopoeia, 3rd Edition, 2003, World Health Organization, Geneva.
5. Fundamental Analytical Chemistry by. D.A. Skoog, D.M. West F.J. Holler and S.R. Crouch. 9th Edition, Mary Finch Publishing, Belmont, CA, USA, 2004.
6. Standard Methods for the Analysis of Oils, Fats and Derivatives, 7th Edition, A. Dieffenbacher and W.D. Pocklington. Blackwell Scientific Publications, London, 1992.
7. Introduction to Environmental Analysis by R.N. Reeve. John Willey & Sons, Ltd., 2002.
8. Environmental Analytical Chemistry by F.W. Fifield and P.J. Haines. Wiley-Blackwell Publishers, 2nd edition, 2000.
9. Chemical Principles of Environmental Pollution by B.J. Alloway and D.C. Ayres. CRC Press, 2nd edition, 1997.



SYLLABUS

Course Title	ADVANCED ANALYTICAL CHEMISTRY	
Course Code	MAC311	
Course Credit	Lecture	: 04
	Tutorial	: 00
	Practical	: 03
	Total	: 07
Detailed Syllabus:		
Sr. No.	Name of chapter & Details	Session Allotted
SECTION-I		
1	<p>Analytical Method Development and Validation:</p> <p>Analytical Method Development - Introduction, method development of API and dosage forms using UV - Visible Spectroscopy, LC and GC.</p> <p>Analytical Method Validation - Importance and scope of Validation, Types of Validation, Validation master plan (VMP), Principles of Process Validation, types of process validation, Prospective validation, Concurrent validation, Retrospective validation, Revalidation, Change control, Cleaning Validation, Design Qualification, Operational Qualification, Installation Qualification, Performance Qualification.</p>	14
2	<p>Bio-Analytical Method Validation:</p> <p>Introduction, ICH guideline of Bioanalytical method validation, different types of matrixes used in BMV, Internal standard used in BMV, sample preparation, P & A Batch and criteria, and validation parameters, Matrix effect, Carry over effect, different types of validations, types of stability in validations, types of extraction techniques used in sample analysis, generation of clinical samples, study sample analysis, Incurred sample Reanalysis, Repeat sample analysis</p>	16
SECTION-II		
3	<p>Stability Study of Drug:</p> <p>Concept of stability of pharmaceuticals. Understanding of statistical aspects in expiry period. Degradation pathways, Physical instabilities & evaluation methods.</p> <p>Stability indicating assay – Types of stability indicating assay method (SIAM), forced degradation studies, SIAM development.</p>	12
4	<p>Impurity Profiling and Validation:</p> <p>Types and sources of impurities in drug substances and products: metal impurity, biological impurities, residual solvents and related substances. Identification, characterization and quantification of impurities. Validation as per ICH guidelines.</p>	12

5	<p>Nano Technology: Introduction of Nano materials, size and properties of nanomaterials, Characterization techniques and applications.</p>	06
List of Practicals (3 Hours/Week):		
<ol style="list-style-type: none"> 1. To separate solvent mixture by GC-MS. 2. Find out organic volatile impurity in samples by GC-MS. 3. To find out area and %RSD of given samples by GC. 4. To interpret Infrared spectrum of a given compounds. 5. To find out λ_{max} of given drug samples (Aspirin, Paracetamol and diclofenac sodium). 6. Determine the effect of solvent on λ_{max} in a given samples by UV spectrophotometer. 7. To generate chromatogram of given samples by HPLC using different modes. 8. Determine amount of Cu^{+2} using DMG by spectrophotometric method. 9. Quantitative determination of aspirin using spectrophotometer. 10. To determine the percentage of salicylic acid by spectrophotometer. 11. To determine the change in UV spectra after derivatization. 		
Instructional Method and Pedagogy:		
<ol style="list-style-type: none"> 1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc. 2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. 3. Surprise tests/Quizzes/Tutorials will be conducted. 4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures. 5. Minimum ten experiments shall be there in the laboratory related to course contents. 		
Students Learning Outcomes:		
<p>At the end of the course the students will be able to:</p> <ul style="list-style-type: none"> ▪ Able to handles the various instruments used for the measurement. ▪ Understand importance of method development and validation in pharmaceuticals and clinical research organization. ▪ Develop a method according to latest internationally recognized standards. ▪ Acquire adequate understanding of process design of pharmaceuticals ▪ Identify the impurities in the APIs and cosmetic products. ▪ Known the importance of stability and degradations of drugs. ▪ Understand basic concept of nano technology and its material. 		
Reference Books:		
<ol style="list-style-type: none"> 1. Pharmaceutical Master Validation Plan: The Ultimate Guide to FDA, GMP and GLP Compliance by S. I. Haider, Taylor & Francis, 2001. 2. ISI Handbook of Food analysis by Indian standards Institution, 1980. 3. Food Science and Technology by S. N. Mahindru, APH Publishing Corporation, New Delhi, 2013. 4. Nanotechnology: An introduction by J. J. Ramsden, 2nd Edition, Elsevier, 2011. 5. Nano Science and Nanotechnology in Engineering by V. K. Varadhan, World Scientific Publishing Company, 2010 6. Cleaning Validation Manual: A Comprehensive Guide for the Pharmaceutical and Biotechnology 		

Industries by S. I. Haider & E. S. Asif, CRC Press, 2010.

7. Validation and Qualification in Analytical Laboratories by L. Huber, 2nd Edition, Informa Healthcare, New York, 2007.
8. Quantitative Analysis of Drugs in Pharmaceutical formulations by P.D. Sethi, 3rd Edition CBS Publishers, 2007.
9. Indian Pharmacopoeia, 7th Edition, 2014.
10. United State Pharmacopoeia, 39th Edition, 2016.
11. Modern Pharmaceutics by G. S. Banker, C. T. Rhodes, 4th Edition, CRC Press, Volume 121, 2002.
12. Nanotechnology: Basic Science and Emerging Technologies by M. Wilson, B. Raguse, CRC Press, 2002.



SYLLABUS

Course Title	CHEMISTRY OF NATURAL PRODUCTS	
Course Code	MOC304	
Course Credit	Lecture	: 04
	Tutorial	: 00
	Practical	: 03
	Total	: 07
Detailed Syllabus:		
Sr. No.	Name of chapter & Details	Session Allotted
SECTION-I		
1	Introduction of Natural Products: Introduction, Classification, source, Primary and secondary metabolite, Extraction and isolation methods of metabolite, General methods for the structure determination of natural products	12
2	Biogenesis and Bioactivity of Natural Products: Biogenesis of Terpenoid and Steroids – mevalonic acid pathway, Shikimate pathway. Activity guided Isolation, Biological activity and bioassay.	08
3	Alkaloids: Introduction of Opium alkaloids ,Structure and synthesis of Morphine, rearrangement in opium alkaloids, structure and synthesis of Sceletium alkaloid A4, structure and synthesis of Mahanimbine, synthesis of Reserpine and Tylophorine.	10
SECTION-II		
4	Terpenoids and Carotenoids: Structure and synthesis of bicyclic sesquiterpenoids Eudesmol and Cadinene, structure and synthesis of Carotene, synthesis of Caryophyllene and (-) Khusimone, molecular rearrangement of Caryophyllene and Logifolene. Importance of vitamin C analogs.	10
5	Steroids: Structure and synthesis of Cholesterol, synthesis of Cortisone, Androgens and Oestrogens, Chemistry of bile acids.	10
6	Vitamins: General isolation method, Structure and synthesis of Vitamin A1, Vitamin B1(Thiamine), Vitamin B6 (Pyridoxine) and Biotin (Vitamin H).Synthesis of Vitamin C	10

List of Practicals (3 Hours/Week):

1. To determine the percentage of tannin content.
2. To determine the amount of starch content in the given sample of turmeric powder.
3. To determine the crude fiber in the given sample of ginger powder.
4. To determine the Rf Value of the sugars present in the given mixture by the techniques of ascending paper chromatography.
5. To determine Rf value of the sugar present in the given mixture by the techniques of Thin layer chromatography.
6. Demonstration of soxhlet apparatus, How to make thimble?, Every parts of Soxhlet assembly, siphon cycle.
7. Identification of sterol compound by Thin layer chromatography.
8. Identification of Alkaloid compound by Thin layer chromatography.
9. Identification of Phenolic and flavonoids compound by thin layer chromatography.
10. To determine ascorbic acid in lemon juice.

Instructional Method and Pedagogy:

1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
3. Surprise tests/Quizzes/Tutorials will be conducted. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
4. Surprise tests/Quizzes/Tutorials will be conducted.

Students Learning Outcomes:

At the end of the course the students will be able to:

- **Learn** synthesis different vitamins, Alkaloids, cholesterol and terpenoids.
- **Identify** biogenesis of natural products.
- **Identify** the natural product compound using different chromatography techniques.
- **Perform** the quantitative analysis of natural product compound.

Reference Books:

1. Chemistry of Natural products by V.K. Ahluwalia, Lalita S.Kumar, Sanjiv Kumar.
2. Organic Chemistry of Natural products by Ayodhya Singh & Seema Singh, campus Publishers (2008).
3. Chemistry of Natural products by S.V. Bhatt, B.A. Nagasampagi, S.Minakshi, Springer- Berlin Heidelberg (2005).
4. Natural Products Chemistry, Vol. I & II, K. Nakanishi et al., Academic press publication (1974)
5. Phytochemical Methods, A guide to modern techniques of plant analysis by J.B. Harbone
6. Thin layer Chromatography by Stahl