

Postgraduate Programmes (M.Sc. Analytical Chemistry)

2023

Course Syllabus

Semester I

1.1 Major (Core)

Course Title Subject Code	Analytical Chemistry Paper I 115211
Course Credits	4
Course Outcomes	After going through the course, learners will be able
	1.To Know the Fundamentals concept of analytical chemistry
	2. To know, how to Prepare different standard solution Theoretically
	3. To developed the knowledge of theoretical concepts of volumetric techniques.
	4. To develop expertise in use of statistical aids to compile, tabulate, evaluate and present analytical data.
Module 1(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able 1. Students able to understand chemometrics of analytical chemistry. 2. Get knowledge of practical and theoretical buffer concepts. 3. Able to understand the types of equilibrium in analytical chemistry
Content Outline	1. Concepts of Analytical Chemistry:- 1: 1 Principle and Theory of Electro analytical Techniques, Advantages, Disadvantages and Applications. 1:2) Scope and function of Electro Analytical Technique. 2. Chemometrics:- 1:1 Data Analysis, Conclusion of a Solution, Percentage by mass, Percentage by Volumetric Mole fraction, Molarity, Normality, Formality. 1:2 Theoretical and practical buffers concepts of formation

	<p>constant calculation of ppb, ppm and dilution of the solution, Stability and instability constant. Calibration of instruments.</p> <p>3. Chemical Equilibrium:</p> <p>1:1 Types of equilibrium in Analytical Chemistry: - Homogeneous method of Analysis Condition, Factors, affecting chemical equilibrium. Heterogeneous method of Analysis Condition, Factors affecting chemical equilibrium.</p> <p>1:2 Classification of Electrolytes:-Acids and Bases:- Strength of Acids and Bases.</p> <p>1:3 Types Of equilibrium constant in Analytical Chemistry.</p>
Module 2(Credit 1)	
Learning Outcomes	After learning the module, learners will be able
<i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	<ol style="list-style-type: none"> 1. Students able to understand Qualitative and Quantitative analysis. 2. Able to understand types of titration. 3. To know the conventional methods of Quantitation.
Content Outline	<p>1.Qualitative and quantitative method of Analysis:-</p> <p>A) Interaction to volumetric method of Analysis :-</p> <p>1:1 Detection of Analyte by volumetric titration.</p> <p>1:2 Principles of Neutralization titration.</p> <p>B) Quantitative Analysis</p> <p>1:1 Gravimetric, Titration, Advantages, Disadvantages of Gravimetric titration, precipitation Titration, Basic Titration method. Titration in aqueous and Non aqueous solvents. Complexometric Titration.</p> <p>1:2 Conventional method of Quantitation.</p> <p>1:3 Construct sigmoidal and linear segment titration curves.</p>
Module 3(Credit 1)	
Learning Outcomes	After learning the module, learners will be able
<i>(Specific related to the module..</i>	<ol style="list-style-type: none"> 1. Get to know about the extraction methods of analysis.

<i>e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	2. Able to understand the concepts of Chromatographic methods.
Content Outline	<p>1.Extraction and Chromatographic Methods of Analysis :-</p> <p>a)Extraction Method</p> <p>1:1 Extraction Equilibrium of cation and anion Exchange resins.</p> <p>1:2 Principle and Instrumentation of super critical fluid Extraction. Advantages, Disadvantages and Applications of Supercritical fluid Extraction.</p> <p>1:3 Selection of Parameters influencing extraction including role of diluents aggregation, third phase formation and counter ION.</p> <p>2.Chromatographic Methods</p> <p>1:1 Principle and Classification of Chromatographic technique.</p> <p>1:2 Technique and application of HPLC and HPTLC.</p> <p>1:3 Size Exclusion Chromatography: - Theory, Type of Packaging, Molecular Mass determination, Purification large Biomolecules.</p>
Module 4(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	<p>After learning the module, learners will be able to</p> <p>1. Able to understand types of error in analytical chemistry.</p> <p>2. Students able to understand hypothetical and statistics testing.</p> <p>3. To know data domain analysis.</p>
Content Outline	<p>1. Data Domain Analysis.</p> <p>1:1 Types of Errors :-</p> <p style="padding-left: 40px;">Instrumental & Non Instrumental Errors. Measurement & Personal Errors, Method Errors, Propagation Errors Accuracy, Precession, Confidence limit.</p> <p>2. Statistics and Hypothetical testing</p> <p>1:1 Chi- Test, F- Test , Q- Test, T-Test, Least Square Method. Correlation Coefficient Mean and Standard deviation.</p>

	1:2 Normal distribution curve, significant figure.
--	----------------------------------------------------

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. – Assignment/Surprise Test
2. – Project
3. – PPT
4. – Industrial Visit / Workshop

Practical Analytical Chemistry Paper I

OBJECTIVES:

- i) Able to prepare standard solutions of various concentrations.
- ii) To develop skills in volumetric titrations.
- iii) Able to separate and estimate elements by solvent extraction method.
- iv) Able to separate and estimate elements and compounds by chromatographic methods.

115223	PRACTICAL	3 credits
Volumetric Analysis	Preparation and Standardization of commonly used titrants, Acid-base titration, redox titration, complexometric titration, Precipitation titration, Non-aqueous titrations.	8 Hours/week
Solvent Extraction Chromatographic Method	Separation and estimation of elements	

References

- Reference Books:**
1. Skoog D.A., West D.M., Holler and Crouch, Fundamentals of Analytical Chemistry, Cengage Learning, Wiley-VCH Weinheim, 2011.
 2. J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, Vogel's Quantitative Chemical Analysis, Pearson Education, ELBS, 6th Edition, 2009.
 3. Fifeild F.W. and Kealey D, Principle & Practice of Analytical Chemistry, Blackwell Science, 5th Edition, 2000.
 4. Gary D. Christian, Purnendu Dasgupta, Kevin Schug, Analytical Chemistry, John Wiley, 7th Edition, 2013.
 5. Douglas A. Skoog, F. James Holler and Stanley R. Crouch, Principles of Instrumental Analysis, Cengage Learning, 6th Edition, 2006.
 6. Ahuja & Jespersen, Modern Instrumental Analysis, Elsevier Science, 1st Edition, 2006.
 7. D.C. Harris, Exploring Chemical Analysis, W.H. Freeman, 3rd Edition, 2005

1.2 Major (Core)

Course Title Subject Code	Food and Biochemical analysis 115212
Course Credits	4
Course Outcomes	<p>After going through the course, learners will be able</p> <p>1) To understand regulation and legislation related to food safety and officers</p> <p>2) Able to compare quality parameters of various food products.</p> <p>3) Able to perform methods of biochemical analysis.</p> <p>4) Students will be able to detect Types , Nutritional value and adulteration test for food products</p> <p>5) This knowledge will enable them to perform better in food industries production cycle and quality control</p>
Module 1(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...</i>	<p>After learning the module, learners will be able</p> <p>1. Students able to understand food safety standards rules and regulations.</p> <p>2. Able to understand food additives and food preservatives.</p> <p>3. To know quality control measures.</p>
Content Outline	<p>A) 1.1 Food laws Regulations and Legislation</p> <p>1.2 Food Safety and Standards Act 2006 and regulations 2011.</p> <p>1.3 Function of regulatory enforcement (Roles and responsibilities of officers</p> <p>B) 1:1 Food Additives & Preservatives</p> <p>1:2 Ideal Characteristics and types of Food Preservatives.</p> <p>1:3 Free radicals (antioxidants) ,Emulsifiers and stabilizers, Anti Caking and Bleaching agents, Flavouring agents.</p> <p>C) 1:1 Quality control and standardization of food products in Industry</p> <p>1:2 Quality control measures, Basic tools of QC.</p> <p>1: 3 Production cycle of food in industry</p>

Module 2(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able to 1. To know contamination in food. 2. Students gain knowledge for parameters in food analysis. 3. To know food colour with chemical structure.
Content Outline	FOOD QUALITY PARAMETERS AND COLOR A. 1:1 Specifications of food quality Contamination in food (physical, chemical, biological) 1: 2 Prevention methods for contamination B . Test for parameters Determination of Moisture, Ash value, Saponification value, Acid value,Iodine value, Peroxide value in food C . Coloring agents in food 1:1 History of food color and types 1:2 Classifications of food colors with chemical structures permitted natural color and extraction methods. 1:3 Health effects of synthetic and natural color
Module 3(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able 1. Students understand preparation and procedures for test analysis. 2. To understand electrolytes sputum test in body. 3. To get the knowledge of body profile test and there test limits.
Content Outline	BIOCHEMICAL ANALYSIS A. 1.1 Preparation and procedure for test , Analysis of blood sample, 1.2 Serum plasma, urinalysis evaluation test.

	<p>B. 1:1 Detection of Blood sugar and methods for record blood sugar.</p> <p>1:2 balance of Electrolytes in body, methods for Sputum test.</p> <p>1.3 Body profile test for Liver, kidney and thyroid gland Functions, structure and test limit</p>
Module 4(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able
	<ol style="list-style-type: none"> 1. Students gain knowledge of types, nutrition values and adulteration 2. To know the tests for dairy products, caffeinated products, bake products, herbivores products and carnivorous products.
Content Outline	<p>FOOD ADULTERATION TEST</p> <p>A. 1:1 Types , Nutritional value and adulteration test for Dairy products:- Butter, cheese, Milk, ice cream</p> <p>B. 1.1 caffeinated products :- Tea , coffee and soft drinks</p> <p>1.2 baked products: - wheat flour, bread, biscuits, confectionery.</p> <p>C. 1: 1 Herbivorous:- Fruit, vegetables, cereals and pulses, honey</p> <p>1: 2 Carnivorous: - Eggs, fish, meat.</p>

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. – Assignment / Surprise Test
2. – Project
3. – PPT
4. – Industrial Visit / Workshop

PRACTICAL FOOD AND BIOCHEMICAL ANALYSIS

Objectives:

- i)Able to analyze milk and milk products.
- ii) To compare analysis of tea and coffee.
- iii) To develop skills in analytical methods of food products

Code: 115224	PRACTICAL	3 Credits
--------------	-----------	-----------

Food Analysis	Milk and Milk Products, Tea, Coffee, Honey, Preservatives. Jam, Jelly, Squash, Edible Oil, Pickle, Sauce, Vinegar	8 Hours/week
---------------	-------------------------------------------------------------------------------------------------------------------	--------------

References

1. George Latimer, Official Methods of Analysis of AOAC International (AOAC = Associate of Analytical Communities), Publication – AOAC, 19th Edition, 2012.
2. Suzanne Nielson, Food Analysis, Springer, 2010.
3. Yeshajahu Pomeranz, Meloan Editor, Food Analysis Theory & Practice, Springer, 2002.
4. Kirk Sawyer, Pearson Composition & Analysis of Food, Longman Scientific & Technical, 9th Edition, 1992.
5. D. B. Wetzel & G. Charalambous, Instrumental Methods in Food and Beverages Analysis, Elsevier Publication, 1998.
6. M.B. Jacob, Chemical Analysis of Food and Food Products, CBSPB Publisher, 3rd Edition, 2006.
7. M. L. Nollet, Handbook of Food Analysis, CRC Press, 2nd edition, 2004.
8. Semih Otles, Handbook of Food Analysis Instruments, CRC Press, 2008.
9. V. Villavecchia, Treatise on Applied Analytical Chemistry, Methods and Standards for the Chemical Analysis of Industrial and Food Vol I & II, Nabu Press, 2012.
10. Editor Dr. Pico Yolanda, Chemical Analysis of Food: Techniques and Applications, Academic Press, 2012.
11. Semih Otles, Methods of Analysis of Food Components and Additives, CRC Press, 2nd Edition, 2011.

1.3 Major (Core)

Course Title Subject Code	Research Methodology 135211
Course Credits	4
Course Outcomes	After going through the course, learners will be able 1. To know Standard chemical safety protocol, Literatures survey & review. 2. To Access and presentation of data practically to chemically 3. Participant will be better equipped with the knowledge of chemical safety and disaster management to work in research field/industries.
Module 1 (Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able 1. Students able to understand basic laboratory techniques. 2. Students gain knowledge On literature survey and review. 3. To know an investigative approach.

Content Outline	<p>Standard chemical safety protocol</p> <p>A) Basic laboratory technique :- fundamental laboratory protocol I and II, handling various chemicals, preparation various concentration of solutions. pH and buffer solutions.</p> <p>B) Literature survey & review:- (collection of data primary, Secondary, tertiary) , Scientific abstracts, Purposes of the Abstract, Characteristics of the Abstract. Formula index.</p> <p>C) The investigative approach: Making and recording measurements, SI units (International System of Units) and their use, Scientific method and design of experiments, Project work.</p>
Module 2(Credit 1)	
<p>Learning Outcomes</p> <p><i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i></p>	<p>After learning the module, learners will be able</p> <ol style="list-style-type: none"> 1. Students gain knowledge of data analysis. 2. To learn presentation of data. 3. To understand e-library resources for information technology.
Content Outline	<p>Access and presentation of data</p> <p>A) Data Analysis:- variables and their types, Accuracy and Precision Scientific Notation, Significance in Measurement ,</p> <p>B) Using graphs, Presenting data in tables, Hints for solving numerical problems, Descriptive statistics, Choosing and using statistical tests, drawing chemical structures, Chemo metrics, Computational chemistry.</p> <p>C) E- library resources fir information technology:- e-book, e-journals, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki-Databases, ChemSpider, Science Direct, SciFinder, Scopus.</p>
Module 3(Credit 1)	
<p>Learning Outcomes</p> <p><i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i></p>	<p>After learning the module, learners will be able</p> <ol style="list-style-type: none"> 1. To learn standard chemical safety procedures. 2. To know safety practices for disposal of waste material. 3. To learn spill response.

Content Outline	<p>A) Standard Chemical safety procedure:- General safety and operational rules, Personal protective equipment's and types , emergency equipment, Material Safety Data Sheet (MSDS), Compressed gas safety.</p> <p>B) Safety practices for disposal of broken glassware, Chemicals, Centrifuge safety, Treated biomedical wastes and scientific ethics.</p> <p>C) Spill response:- Chemical spills, Radiation spills, Biohazard spills, Fires, Medical emergency, Accident reporting</p>
Module 4(Credit 1)	
Learning Outcomes (<i>Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...</i>)	<p>After learning the module, learners will be able</p> <ol style="list-style-type: none"> 1. To understand acts and rules for waste management. 2. To have knowledge of nuclear disaster.
Content Outline	<p>A) The Indian Atomic Energy Act, 1948, The Hazardous and Other Waste (Management and Trans boundary Movement) Rules, 2016, The Bio-Medical Waste Management Rules, 2016,</p> <p>B) Nuclear Disasters: 1984, Chernobyl Disaster, 1986, Fukusima Daiichi nuclear disaster, 2011.</p> <p>C) Chemical Disaster:- Bhopal Gas Disaster,</p>

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. – Assignment/Surprise Test
2. – Project
3. – PPT
4. – Industrial Visit / Workshop

References

Reference Books:

1. J. R. Dean, A. M. Jones, D. Holmes, R. Reed, J. Weyersand A Jones, Practical Skills in Chemistry, Pearson Education Ltd. [Prentice Hall], 2002.
2. C. R. Kothari, Research Methodology: Methods and Techniques, New Age International, 2013.
3. A. K. Singh, Tests, Measurements and Research Methods in Behavioral Sciences, BhartiBhawan Publisher And Distributor, 2012.
4. Martyn Denscombe, The Good Research Guide, McGraw-Hill International, 2007.
5. Ranjit Kumar, Research Methodology, Sage Publication Ltd, 3rdEdition, 2011.
6. Edited by J.C. Taylor, Advances in Chemistry Research, Vol 17, Nova Science Publishers INC, 2013.
7. Oklahoma State University Laboratory Safety Manual, 1999.
8. Margaret DianeLe Compte, Wendy L. Millroy, Judith Preissle, The Handbook of Qualitative Research in Education, Academic Press Inc
9. Bohdan O, Szuprouiez, Multimedia Networking,Mcgraw-Hill
10. Introduction to Research, TynesHillway Houghton Wiffin Company, 2005.

1.4 Major (Elective)

Course Title Subject Code	Drug Laws & Packaging 125211
Course Credits	4
Course Outcomes	After going through the course, learners will be able
	1.Students gain knowledge of basic regulation and legislation of drugs
	2.To compare standards of ISI, AGMARK, ISO, WHO
	3.To know the importance of products Certification
	4.To know the importance of GDP,GMP,GLP
	5.To promote good practices to become better professional.
Module 1(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able
	1. To understand role of drug and cosmetic acts. 2. Importance of US FDA 3. To know the role of government authorities.
Content Outline	A) Pharmaceutical legislation and Regulation of drugs:- 1:1 drugs and cosmetics act 1940, Objective, administration of act and rules, 1:2 Pharmaceutical act 1948, Objective, administration process, function of PCI.
	B) 1:1 US-FDA function, structure of organization, approval process of drugs 1:2 ICH and its guidelines 1:3 EU Regulation, purpose of European Medicines Agency (EMA), committee of EMA and their role C) The role of Govt. Authorities, their qualification, duties, powers and procedure to be followed.

Module 2(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able to
	1. To know the statutory status of pharmacopoeia. 2. Importance of European Pharmacopoeia.
Content Outline	A) Statutory status of pharmacopoeia:- structure of pharmacopoeia, Monograph, extra pharmacopoeia (martindale), Penalties for drug law offenses B) Pharmacopoeia-IP, Features of various Editions of Indian Pharmacopoeia, Ayurvedicpharmacopoeia. C) EU-pharmacopoeia, British Pharmacopoeia, national formulary, CODEX
Module 3(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able to
	1. Students gain knowledge of food safety and quality. 2. To know certification marks issued for different products. 3. To understand ISO objective and standards
Content Outline	A) Food safety and quality:- FSSAI-2006, function Prevention of Food Adulteration Act, 954, Fruit Products Order(1955,) Meat Food Products Order1973, Vegetable Oil Products (Control) Order, 1947, Edible Oils Packaging (Regulation) Order 1988,Solvent Extracted Oil, De- Oiled Meal and Edible Flour (Control) Order, 1967, Milk and Milk Products Order, 1992 B) Certification Marks issued For Different Products AGMARK (Standardization & grading of Agriculture and allied produce) , Bureau of Indian Standards (BIS),ISI (Indian Standard for Industrial Products), eco mark Certification FPO mark(fruits Products Order) C) ISO (International Organization of Standardization):- Objective, ISO standards

Module 4(Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
<i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	<ol style="list-style-type: none"> 1. To learn Good practices 2. To know the packaging 3. To understand packing and labeling
Content Outline	<p>A) Good Practices :-</p> <p>Philosophy of Good manufacturing Practices, Practices, current Good documentation practices (cGDP). Concept of good manufacturing practices (CGMP), Concept of good laboratory practices (CGLP).</p> <p>B) Packaging:- ideal packaging, different type of packaging, factors influence the packaging, packaging material, pharmaceutical packaging Testing</p> <p>C) Packaging and labeling:- Goods safety and standard (packaging and labeling) Regulation</p>

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

- 1.– Assignment/ Surprise Test
- 2.– Project
- 3.– PPT
- 4.– Industrial Visit / Workshop

References

1. Handbook on Modern Packaging Industries, NIIR Project Consultancy Services, Asia Pacific Business Press Inc., 2ndEdition, 2010.
2. Edward Baur, Pharmaceutical Packaging Handbook, Publisher Taylor and Francis, 2009.
3. G. L. Robertson, Food Packaging Principle & Practice, CRC Press, 3rdEdition, 2012.
4. Mehta, Handbook of Drug Laws, University Book Agency Allahabad.
5. Govt. of India Publications of Food Drug Cosmetic Acts and Rules.
6. Malik Vijay, Laws Relating to Drugs And Cosmetics, Eastern book comp, 23rdEdition, 2013.
7. Indian Pharmacopoeia, British Pharmacopoeia

SEMESTER II

2.1 Major (Core)

Course Title Subject Code	ANALYTICAL CHEMISTRY PAPER II 215211
Course Credits	4
Course Outcomes	After going through the course, learners will be able
	1. TO CORRELATE PRINCIPLE AND WORKING OF DIFFERENT TYPES OF INSTRUMENTS USED FOR ANALYSIS.
	2.TO APPLY THESE TECHNIQUES PRACTICALLY.
	3.TO USE THESE TECHNIQUES IN RESEARCH AND ANALYSIS.
Module 1(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able
	1. To learn IR spectroscopy and method of analysis. 2. To understand process of AAS 3. To learn derivatives and dual wavelength spectroscopy.
Content Outline	<p>A) Spectroscopic methods of analysis.</p> <p>a) Infrared Spectroscopy.</p> <p>1:1 Theory and principle of Infrared Spectroscopy.</p> <p>1:2 Instrumentation of IR Spectroscopy.</p> <p>1:3 Type of Vibration.</p> <p>1:4 Advantages, Disadvantages and Applications of IR.</p> <p>1:5 FTIR – Fourier Transform Infrared spectroscopy.</p> <p>B) Atomic Absorption Spectroscopy.</p> <p>1:1 Theory and Instrumentation of AAS.</p> <p>1:2 Process of Atomization.</p> <p>1:3 Types of Source.</p> <p>1:4 Type of Detectors.</p> <p>Applications, Advantages and Disadvantages of AAS</p> <p>C) Derivatives and Dual Wavelength Spectroscopy.</p> <p>1:1 Theory and instrumentation of Dual Wavelength Spectroscopy.</p> <p>1:2 Application Advantage and Disadvantages of Dual Wavelength Spectroscopy.</p> <p>1:3 Components of Dual Wavelength Spectroscopy.</p>

Module 2(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able to
	<ol style="list-style-type: none"> 1. Students able to understand atomic emission spectroscopy 2. Students gain knowledge of molecular emission spectroscopy. 3. To understand flame emission spectroscopy.
Content Outline	<p>Emission Spectroscopic Methods.</p> <p>A) Atomic Emission Spectroscopy.</p> <p>1:1 Instrumentation and Theory of AES.</p> <p>1:2 Sources of Nonlinearity in AES.</p> <p>1:3 Line – Width Effects in AES.</p> <p>1:4 Application, Advantage and Disadvantages of AES.</p> <p>B) Molecular Emission Spectroscopy.</p> <p>1:1 Theory and Instrumentation of MES.</p> <p>1:2 Factors affecting Fluorescence and Phosphorescence.</p> <p>1:3 Qualitative and Quantitative Applications.</p> <p>1:4 Chemiluminescence :- Introduction, Principle and types of Chemiluminescence.</p> <p>C) Flame Emission Spectroscopy.</p> <p>1:1 Introduction and Theory of FES.</p> <p>1:2 Principle and Instrumentation of FES.</p> <p>1:3 Types of Burner and Types of Detector in FES.</p> <p>1:4 Advantages and Disadvantages of FES.</p>
Module 3(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able
	<ol style="list-style-type: none"> 1. To learn potentiometry method of analysis. 2. To know different types of potentiometric titration
Content Outline	<p>Potentiometric Methods of Analysis :-</p> <p>1:1 Theory and Instrumentation of Potentiometric methods of analysis.</p> <p>1:2 Components of Potentiometric Cell.</p> <p>1:3 Types of Potentiometric Titration.</p> <p>1:4 Nernst Equation of Potentiometry</p>
Module 4(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able
	<ol style="list-style-type: none"> 1. Students able to understand polarography. 2. To learn stripping and voltammetry. 3. To know coulometry

	A) Polarography.
Content Outline	<p>1:1 Importance and Development of Voltammetric Techniques and Comparison With Classical DC Polarography.</p> <p>1:2 Types of Polarography.</p> <p>1:3 Components of Polarography.</p> <p>1:4 Polarography Curve.</p> <p>1:5 Type of currents.</p> <p>1:6 Merit Demerits and Scope of Polarography.</p> <p>B) Stripping Voltammetry.</p> <p>1:1 Principle of Stripping Voltammetry.</p> <p>1:2 Types of Stripping Voltammetry.</p> <p>1:3 Graph with Suitable Example of Stripping Voltammetry.</p> <p>1:4 Merit Demerit and Scope of Stripping Voltammetry.</p> <p>C) Coulometry.</p> <p>1:1 Types of Coulometric Methods.</p> <p>a) Controlled Potential Coulometry.</p> <p>b) Controlled Current Coulometry.</p> <p>1:2 Theory and Instrumentation of Coulometry.</p> <p>1:3 Advantage and Limitation of Coulometry.</p>

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

- 1.– Assignment/Surprise Test
- 2.– Project
- 3.– PPT
- 4.– Industrial Visit / Workshop

Practical Analytical Chemistry Paper - II

Objectives:

- i) Able to handle colorimetric instruments for analysis.
- ii) To develop skills in chromatographic techniques for analysis.

215224	PRACTICAL	3 credits
Spectroscopy	Colorimetric analysis of elements, Mixture, Simultaneous estimation of metals, pK value of indicator by Spectrophotometry.	8 Hours/week
Chromatography	Chromatography- Ion- exchange chromatography, Thin layer chromatography.	

References

Reference Books:

1. Skoog D.A., West D.M., Holler and Crouch, Fundamentals of Analytical Chemistry, Cengage Learning, Wiley-VCH Weinheim, 2011.
2. J. Mendham, R.C.Denney, J.D.Barnes, M.J.K. Thomas, Vogel's Quantitative Chemical Analysis, Pearson Education, ELBS, 6th Edition, 2009.
3. Fifeild F.W. and Kealey D, Principle & Practice of Analytical Chemistry, Blackwell Science, 5th Edition, 2000.
4. Gary D. Christian, Purnendu Dasgupta, Kevin Schug, Analytical Chemistry, John Wiley, 7th Edition, 2013.
5. Douglas A. Skoog, F. James Holler and Stanley R. Crouch, Principles of Instrumental Analysis, Cengage Learning, 6th Edition, 2006.
6. Ahuja & Jespersen, Modern Instrumental Analysis, Elsevier Science, 1st Edition, 2006.
7. D.C. Harris, Exploring Chemical Analysis, W.H. Freeman, 3rd Edition, 2005.
8. Edited by Pradyot Patnaik, Dean's Analytical Chemistry Handbook, McGraw Hill, 2nd Edition, 2004.
9. Klaus Danzer, Analytical Chemistry, Springer-BBH, 2007.
10. A.L. Underwood, Quantitative Analysis, Prentice-Hall of India Pvt Ltd., 1999.

2.2 Major (Core)

Course Title Subject Code	Cosmetics Formulation & Quality Control 215212
Course Credits	4
Course Outcomes	After going through the course, learners will be able to
	1. Assist with understanding cosmetic formulation procedures.
	2. be aware of the benefits and drawbacks of the raw ingredients used in the manufacture of cosmetics.
	3. Capable of evaluating the significance of quality control procedures in the cosmetics industry.
	4. Capable of analyzing cosmetic compositions for personal and
	5. Professional development.
Module 1(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able
	1. Skin and it's natural composition. 2. Process used in manufacturing of cosmetics. 3. To understand commonly used raw material.
Content Outline	Plant layout and factory requirements for cosmetic industry <ul style="list-style-type: none"> ● Location and surroundings ● Lighting and ventilation ● Waste disposal and sanitation Packaging facilities etc.
Module 2(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able to
	1. To understand plant layout and factory requirements in cosmetic industry.

<p>Content Outline</p>	<p>A. Skin and its natural composition</p> <ul style="list-style-type: none"> ● Types of skin ● Anatomy of skin ● Layers of epidermis and skin cell types ● Skin barrier ● Skin pigmentation ● Skin pH, sensitivity, and diseases. <p>B. Processes used in the manufacturing of cosmetics</p> <ul style="list-style-type: none"> ● Emulsification ● Mixing ● Gelling ● Compaction ● Molding ● Packaging <p>B Commonly used raw materials in the cosmetic industry</p> <ul style="list-style-type: none"> ● Water ● Preservatives ● Colors both natural and synthetic <p>Perfumes both natural and synthetic</p>
<p>Module 3(Credit 1)</p>	
<p>Learning Outcomes</p> <p><i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i></p>	<p>After learning the module, learners will be able</p> <ol style="list-style-type: none"> 1. To understand Herbal Preparation products 2. To know the Baby care products and hypoallergic preparation.
<p>Content Outline</p>	<p>A Mainly used cosmetic formulations:</p> <ul style="list-style-type: none"> ● Skin creams and lotions ● Face Powders and compacts ● Lipsticks and lip balms ● Shampoos and shaving preparations ● Manicure preparations

	<ul style="list-style-type: none"> ● Hair grooming preparations (sprays and gels etc.) ● Nail lacquers ● Suntans and anti-sunburn preparations ● Dentifrices ● Hair colorants <p>B. Cosmetic products mostly used in recent times .</p> <p>Herbal preparations for:</p> <p>Skin, Nails, Hair, Face, Dentifrices, and Mouthwashes etc.</p> <p>C. Baby care products and hypoallergenic preparations:</p> <p>powders, oils, lotions, shampoos, creams etc</p>
Module 4(Credit 1)	
<p>Learning Outcomes</p> <p><i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i></p>	<p>After learning the module, learners will be able to</p> <ol style="list-style-type: none"> 1. Capable of evaluating the significance of quality control procedures in the cosmetics industry. 2. Capable of analyzing cosmetic compositions for personal
<p>Content Outline</p>	<p>A. Controlling the quality of the following cosmetics-related raw materials:</p> <ul style="list-style-type: none"> ● Goods inspection report, total viable aerobic count, membrane filtration, plate count, serial dilution, and determination of specific bacteria (Escherichia, salmonella, pseudomonas, staphylococcus, etc.) ● Intermediate and bulk finished goods: fineness, texture, apparent density, color shade and match, odor, emulsion homogeneity, softening point, melting range , foam, and foam stability. <p>B. Cosmetics analysis:</p> <ul style="list-style-type: none"> ● Lipstick (separation of waxes and oil & analysis of colors), ● Face powder (fats & fatty acids, boric acid, zinc, total titanium & iron),

	<ul style="list-style-type: none"> ● Creams (types of emulsion,% water, ash, and chloroform soluble substance), ● Shampoo (analysis of nonvolatile matter, borate, sulfate, phosphates, and surfactants), ● Nail Enamel (Bismuth Oxy Chloride, Free Formaldehyde). <p>C.Test procedures for cosmetic items:</p> <p>repeated insult, contact urticaria, primary and secondary irritants, skin sensitivity, patch, and photo-patch</p>
--	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

- 1.– Assignment / Surprise Test
- 2.– Project
- 3.– PPT
- 4.– Industrial Visit / Workshop

References

1. Edited by Martin M. Reiger, Harry's Cosmeticology, Chemical Publishing Co. Inc,8thEdition, 2009.
2. P.P. Sharma, Cosmetics, Formulations, Manufacturing and Quality Control, Vandana Publication Ltd,4thEdition,2010.
3. M. S. Balsam & E. D. Sagarin, Cosmetics Science & Technology, Wiley Interscience Publication, 2ndEdition, 2008.
4. H. Panda, Herbal Cosmetics, Asia Pacific Business Press Inc., 2008. 5. B. M. Mittal & R. N. Saha, Handbook of Cosmetics, Vallabh Prakashan, New Delhi, 2008.
6. S. Nanda and R. K. Khar, Cosmetic Technology, Birla Publications Pvt Ltd, 1stEdition, 2006.
7. George Latimer, Official Methods of Analysis of AOAC International (AOAC = Associate of Analytical Communities), 19thEdition,Publication –AOAC, 2012.
8. M. L. Schlossman, Chemistry and Manufacture of Cosmetics, Allured Publishing Corporation, 4thEdition, 2009.
9. A. O. Barel, N. Paye, H. I. Maibach, A Handbook of Cosmetics Science and Technology, 3rdEdition, 2009.
10. A. Salvador, A. Chisvert, Analysis of Cosmetic Products, Publisher – Elsevier, 2011.
11. P. Elsner, H. I. Maibach, Cosmeceuticals and Active Cosmetics, Taylor & Francis, 2ndEdition, 2005.

2.3 Major (Core)

Course Title Subject Code	Environmental Science 215213
Course Credits	4
Course Outcomes	After going through the course, learners will be able
	1. To know the different types of environmental pollutants and their global impact.
	2. Methods for control of environmental pollution.
	3. Analysis of pollutants and their management
	4. Environmental Legislation and Contemporary Environmental Issues
Module 1(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able
	1. to know Sources and classification of pollution. 2. to understand the Concepts DO COD & BOD 3. To know the Types of pollution
Content Outline	<p>A) Source and classification pollution</p> <p>Composition of air. Particles, ions and radicals in the atmosphere. Chemical formation of inorganic and organic particulate matters, Oxygen and Ozone chemistry. Photochemical smog.</p> <p>B) Concept of DO, BOD and COD. Sedimentation, coagulation, flocculation, filtration, pH and Redox potential (Eh). Inorganic and organic components of soils. Biogeochemical cycles nitrogen, carbon, phosphorus and sulfur</p> <p>C) Types of pollution:- Air, water, noise, soil, thermal marine radioactive.</p>
Module 2(Credit 1)	
Learning Outcomes <i>(Specific related to the module..</i>	After learning the module, learners will be able to
	1. Students gain knowledge of Principle and working of instruments used in pollution control.

<i>e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	2. Know the Method to control water pollution. 3. Understand the concept of noise control.
Content Outline	<p>Methods to control of pollution:-</p> <p>A) 1:1 Principle and working of Electrostatic precipitation, wet & dry scrubber, filters, gravity and cyclonic separation, Adsorption, absorption and condensation of gaseous effluent.</p> <p>B) 1:2 Methods of control of water pollution: water and wastewater treatment Primary, Secondary and Advanced treatment methods.</p> <p>C) 1:1 Active and Passive methods. Vibrations and their measurements for noise control 1:2 Modifications in Pesticides and synthetic Fertilizers for improving soil.</p>
Module 3(Credit 1)	
<p>Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i></p>	<p>After learning the module, learners will be able to</p> <p>1. Analysis of pollutants. 2. Hazardous waste management. 3. Understand the concept of e-waste, plastic waste and fly ash.</p>
Content Outline	<p>Analysis of pollutants and their management</p> <p>A) 1:1 Analysis of gasses CO, CO₂, NO₂, SO₂, H₂S. 1:2 Analysis of toxic heavy metals Cd, Cr, As, Pb, Cu,Hg</p> <p>B) Hazardous waste management: Treatment Methods neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration and final disposal.</p> <p>C) 1:1 e-waste: classification, methods of handling and disposal. 1:2 Fly ash: sources, composition and utilization. 1:3 Plastic waste: sources, consequences and management.</p>
Module 4(Credit 1)	
<p>Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i></p>	<p>After learning the module, learners will be able to</p> <p>1. Know the Environmental legislation and contemporary environmental issue. 2. Know the Environmental disaster.</p>

Content Outline	Environmental Legislation and Contemporary Environmental Issues A) 1:1 Environmental (Protection) Act, 1986 and Rules 1986, 1:2 The Plastic Waste Management Rules 2016, 1:3 The Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules 2000, 1:4 Coastal Regulation Zones (CRZ) 1991 amended from time to time. B) Environmental Disasters: 1.2 Minamata Disaster, 1.2 Love Canal Disaster
------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

- 1.– Assignment / Surprise Test
- 2.– Project
- 3.– PPT
- 4.– Industrial Visit / Workshop

References

Reference Books:

1. A.K. De, Environmental Chemistry, New Age International Publication, 5th Edition, 2005.
2. Wark K. & Werner C., Edited by David and Liptak, Air Pollution, CRC press LLC, 3rd Edition, 2000.
3. S.P. Mahajan, Environmental Pollution Control in Process Industries, Tata McGraw Hill Publishing Co. Ltd, 2008.
4. B.K.Sharma H. Kaur, Environmental Pollution, Krishna Prakashan Media Pvt Ltd, 2001.
5. R.K. Trivedi, P.K. Goyal, Introduction to Air pollution, ABD publisher, 2003.
6. P.K.Goyal, Water Pollution: Causes Effect and control, New Age International Publication, 2006.
7. S. M. Khopkar, Environmental Pollution Analysis, New Age International Publication, 2011.
8. C. S. Rao, Environmental Pollution Control Engineering, New Age International, 2007.
9. R. Engel, Edited By Ryden Powell, Migula Anderson, Environmental Sciences, Baltic Univ. Publication, 2003.
10. Arvind Kumar, Water Pollution, APH Publishing, 2004.
11. G.S. Sodhi, Fundamental Concepts of Environmental Chemistry, Alpha Science, 2nd Edition, 2005.
12. S.G. Misra & Dinesh Mani, Soil Pollution, APH Publishing Corporation, 2009.
13. S.S. Dara, A Textbook of Environmental Chemistry & Pollution Control, S. Chand Ltd, New Delhi, 2006.

2.4 Major (Elective)

Course Title Subject Code	Pharmaceutical Analysis 225211
Course Credits	4
Course Outcomes	After going through the course, learners will be able
	1. To identify the active pharmaceutical components in medicinal products.
	2. To comprehend the administration method and dosage type.
	3. Capable of consulting and contrasting pharmacopeias for various parameters and studies.
	4. To link the fundamental QA and QC concepts in the pharmaceutical sectors.
Module 1(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able to
	1. Know the Classification of doses form 2. Know the Scope of pharmaceutical analysis.
Content Outline	<p>A) Introduction to pharmaceutical Analysis:</p> <p>1.1 Definition and scope of Pharmaceutical Analysis</p> <p>1.2 Importance and objectives of pharmaceutical analysis</p> <p>1.3 Classification of analytical technique</p> <p>B) Introduction to Indian Pharmacopoeia (IP) and other pharmacopeial standards</p> <p>1.1 Pharmacopoeia and its importance.</p> <p>1.2 Dosage form: A brief description of each dosage form, including tablets, capsules, injections, ointments, creams, oral solutions, and aerosols etc.</p>
Module 2(Credit 1)	

Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able to
	<ol style="list-style-type: none"> 1. Know the Application of analytical methods used pharmaceutical industries. 2. Understand the Sustain and control released formation.
Content Outline	Application of Analytical methods used in the pharmaceutical industry 1.1 Tests to determine the authenticity, purity, and dosage of medicines. 1.2 Impurities and limit tests for (As, Pb, Fe, Chloride, Sulphate etc.) 1.3 Sustained and Control release formulations.
Module 3(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able
	<ol style="list-style-type: none"> 1. To understand quality assurance 2. To know quality control
Content Outline	Principles and tests for quality control in the pharmaceutical industry: raw materials and finished products A) Quality Assurance (QA), the idea of Total Quality Management, and the role of documentation in QA. B) . Quality Control (QC) - Change control management, out of specifications, Deviation reporting, Stability studies, Quality control, laboratory duties, regular controls, equipment calibration, standard test protocols.
Module 4(Credit 1)	
Learning Outcomes <i>(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. ...)</i>	After learning the module, learners will be able
	<ol style="list-style-type: none"> 1. To know Analysis of Chemotherapeutic agents 2. To know dissolution and disintegration. 3. To learn microbial testing and preparation of pharmaceutical products

Content Outline	<p>A) Introduction, Type, Properties, and Method of Analysis of Chemotherapeutic Agents.</p> <p>B) Dissolution and disintegration, drug testing, Biron capsules, vitamin C tablets, vitamin B2, Aspirin, ibuprofen, streptomycin sulphate, Bcalcium lactate, laxatives and antacid.</p> <p>1.1 Microbiological testing of pharmaceutical products</p> <p>1.2 Antibiotic sensitivity testing for various antibiotics on Escherichia coli and Staphylococcus aureu</p> <p>C) Microbial testing for water used to prepare pharmaceutical products.</p> <p>Testing of various pharmaceutical products for sterility using appropriate microbiological media.</p>
------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

- 1.– Assignment / Surprise Test
- 2.– Project
- 3.– PPT
- 4.– Industrial Visit / Workshop

PRACTICAL PHARMACEUTICAL ANALYSIS

Objectives:

- i) Able to analyze various drugs by standard methods.
- ii) Able to compare dissolution and disintegration tests for different drugs.

245221	PRACTICAL	3 credits
Drugs Analysis	Assay of alkaloids, Vitamins, Antibiotics, Sulpha drugs, Anta-acids, Anti-bacterials.	8 Hours/week
	Dissolution test, Disintegration test, Weight variation test, Test for uniformity of content.	

References

Reference Books:

1. Beckett & Stenlake, Practical Pharmaceutical Chemistry Vol (I) (II), CBS Publisher, 4th Edition, 2006. 2. V. K. Selvaraj, Practical Pharmaceutical Chemistry, Campus Books International Publisher, 2012.
3. Editor J. D. Nally, Good Manufacturing Practices for Pharmaceuticals, CRC Press, 6th Edition, 2006.
4. Edited by A. A. Signore and T. Jacobs, Good Design Practices for GMP Pharmaceutical Facilities, CRC Press, 2005.
5. Indian Pharmacopoeia (Latest Edition)
6. British Pharmacopoeia (Latest Edition)
7. Edited by Allen, Loyd Jr., Remington The Science & Practice of Pharmacy, Publication Pharmaceutical Press, 22nd Edition, 2012.
8. D.G. Watson, Pharmaceutical Analysis, Churchill Livingstone Publisher, 3rd Edition, 2012. 9. Edited by L. Ohannesian and A. Streeter, Handbook of Pharmaceutical Analysis, CRC Press, 2001.
10. M. E. Aulton, Dosage Form, Churchill Livingstone Publisher, 2nd Edition, 2001. 11. J. Wiley, Text Books of pharmaceutical Analysis, Connors, 2001
12. Higuchi, Chemical Analysis of Drug, Interscience, 1995

Terminologies

Abbreviation	Full-form	Remarks	Related to Major and Minor Courses
Major (Core)	Main Discipline		
Major (Elective)	Elective Options		related to the Major Discipline
Minor Stream	Other Disciplines (Inter/Multidisciplinary) not related to the Major	either from the same Faculty or any other faculty	
OEC	Open Elective Courses/ Generic		Not Related to the Major and Minor
VSEC	Vocational and Skill Enhancement Courses		
VSC	Vocational Skill Courses		Related to the Major and Minor
SEC	Skill Enhancement Courses		Not Related to the Major and Minor

AEC	Ability Enhancement Courses	Communication skills, critical reading, academic writing, etc.	Not Related to the Major and Minor
VEC	Value Education Courses	Understanding India, Environmental science/education, Digital and technological solutions, Health & Wellness, Yoga education, sports, and fitness	Not Related to the Major and Minor
IKS	Indian Knowledge System	I. Generic IKS Course: basic knowledge of the IKS II. Subject Specific IKS Courses: advanced information pertaining to the subject: part of the major credit.	Subject Specific IKS related to Major
VAC	Value-Added Courses		Not Related to the Major and Minor
OJT	On-Job Training (Internship/Apprenticeship)	corresponding to the Major Subject	Related to the Major
FP	Field projects	corresponding to the Major Subject	Related to the Major
CC	Co-curricular Courses	Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/Visual/ Performing Arts	Not Related to the Major and Minor
CE	Community Engagement and service		Not Related to the Major and Minor
RP	Research Project	corresponding to the Major Subject	Related to the Major