Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science, Commerce, Baramati

(Autonomous)

DEPARTMENT OF CHEMISTRY

(Faculty of Science and Technology)

Two Year M.Sc. Degree Program Chemistry

M.Sc. II Analytical Chemistry

(2019 Pattern)

Choice Based Credit System Structure and Syllabus

(To be implemented from June 2019)

CHA-5401
Forensic science
(48 L+ 12 T) (4 Credit)

Course Objectives:

The students are expected to learn,

1. Student should know methods of evidence collection.
2. To study about the analysis of hair components.
3. To study DNA fingerprinting.
4. Student will learn to make reports on various cases.
5. Students will be able to draw appropriate scientific conclusions from evidence andexperimental data.
6. Student will learn to handling on various instruments.
7. Demonstrate competency in the collection, processing, analyses, and evaluation of evidence.

Course Outcomes:

CO1. Student should learn about how to collect, store & analyses all types of evidences.
CO2. Student should understand the various techniques for analysis of evidences.
CO3. Student should understand the methods like PCR, RFLP, STR.
CO4. Student should learn about methods of hair, drug, blood, alcohol analysis.
CO5. Students will be able to learn how the principles of the forensic science use to solvecriminal cases.
CO6. Students will learn to generate reports on different cases.
CO7. Students will be able to Fingerprint analysis.

1. **Forensic analysis** **(2L)**
   Overview, destructive and non-destructive techniques, data interpretation

2. **Blood analysis** **(3L)**
   Blood preservation and aging effects, analysis of blood components and exogenic substances, bloodstainanalysis.

3. **DNA Profiling** **(4L)**
   DNA and its polymorphism, DNA typing procedures- RFLP, PCR, MVR-PCR, Dot – Plot, AMP-FLP, STR, other methods, paternity testing, applications, interpretation andpractical use.

4. **Determination of alcohol in body fluids** **(4L)**
   Legal background, sampling and sample preservation, analysis G-,IR,enzymatic and othermethods

5. **Fingerprint analysis (4L)**
   Latent fingerprints, optical, physical, physico-chemical and chemical detection methods, fingerprints in blood, fingerprint detection sequences

6. **Hair analysis (5L)**
   Structure and composition of hair, morphological examination, chemical analysis of hair components and components remaining on or in hair.

7. **Systematic Drug identification (6L)**
   Classification and categories of compounds involved, analytical-strategy-EMIT, FPIA, TLC, LC, GC-MS etc., requirements for identification, possibilities and limitations of selected techniques, isotope detection method with numerical, new druggroups.

8. **Materials of interest for forensic studies (20L)**
   a. **Explosives:** Types, analytical methods for identification of low and high explosives in post- blast debris.
   b. **Fibers:** Fibers encountered at cyber scene, identification of type, dye extraction and analysis, colour matching, analysis for metals, additives and contaminants-SEM-EDX, XRD and XRF.
   c. **Paints,Varnishes and Lacquers:** Formulation of paints, types of samples, sample pre- treatment prior to analysis, colour measurements, Analysis by SEM, SEM-SPMA, TEM- TLC/HPTLC, AES, XRF.
   d. **Glass:** As forensic evidence, measurement of physical properties, elemental analysis- XRD, NAA, interpretation of results, casework examples.
   e. **Arson residue:** Nature of evidence, chemical evidence, properties of liquid accelerants, sampling and sample pre-treatment, laboratory examination of suspect arson evidence, evidential value.
   f. **Gunshot residues:** Composition of sources, detection on hands and its limitation, determination of muzzle-to-target distance, elemental and inorganic analysis, numerical on estimation of energy released bycombustion reactions.

References:

1. ‘Forensic chemistry’ by Suzanne Bell, Pearson Prentice Hall Publishers,2006
2. Encyclopaedia of Analytical Chemistry, Volume 3, Academic press,1995

Choice Based Credit System Syllabus
(2019 Pattern)

Class: M.Sc. II (SEM IV) **Subject**: Analytical Chemistry
Course: Forensic Science **Course Code**: CHA-5401
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Program Outcomes with Course Outcomes

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	2	1	3	2	2	2	2	2
CO 2	2	3	2	2	3	1	1	2	2
CO 3	2	2	3	2	1	2	1	2	2
CO 4	3	2	2	3	2	1	2	2	2
CO 5	2	3	1	2	3	2	2	2	2
CO 6	2	1	2	1	2	3	2	2	2
CO 7	2	1	1	2	2	2	3	2	2

Program Outcome 1 (PO 1: Disciplinary Knowledge):
CO 1: Students should learn about how to collect, store & analyze all types of evidence.
CO 4: Students should learn about methods of hair, drug, blood, and alcohol analysis.
Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):
CO 1: Students should learn about how to collect, store & analyze all types of evidence.
CO 2: Students should understand the various techniques for the analysis of evidence.
CO 5: Students will be able to learn how the principles of forensic science are used to solve criminal cases.
CO 6: Students will learn to generate reports on different cases.
Program Outcome 3 (PO 3: Social Competence):
CO 3: Students should understand methods like PCR, RFLP, and STR.
CO 7: Students will be able to do Fingerprint analysis.
Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):
CO 1: Students should learn about how to collect, store & analyze all types of evidence.
CO 3: Students should understand methods like PCR, RFLP, and STR.
CO 4: Students should learn about methods of hair, drug, blood, and alcohol analysis.
Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):
CO 1: Students should learn about how to collect, store & analyze all types of evidence.
CO 5: Students will be able to learn how the principles of forensic science are used to solve criminal cases.
Program Outcome 6 (PO 6: Personal and Professional Competence):
CO 2: Students should understand the various techniques for the analysis of evidence.
CO 5: Students will be able to learn how the principles of forensic science are used to solve criminal cases.
CO 6: Students will learn to generate reports on different cases.
Program Outcome 7 (PO 7: Effective Citizenship and Ethics):
CO 7: Students will be able to do Fingerprint analysis.

CHA-5402
Advances in Analytical Techniques
(48 L+ 12 T) (4 Credit)

Course Objectives:

The students are expected to learn,

1. To learn about principle & instrumentation of different types of spectroscopies.
2. Advanced electroanalytical techniques
3. Students are learning the solvent extraction techniques.
4. Students will be able to get clear idea in different type of spectroscopy
5. Learning applications of instruments in industrial purpose.
6. Should able to explain instrumentation and methodology in analytical extraction.
7. Solve numerical problems on analytical extraction.

Course Outcomess:

CO1. Student should understand various methods of solvent extraction techniques.
CO2. Student should understand AAS, AFS, AMS techniques.
CO3. Student learns applications of atomic spectroscopy.
CO4. Student should solve numerical.
CO5. Student should able to differentiate among the methods of analytical extraction.
CO6. Apply /select particular method of analysis for sample to be analyzed.
CO7. Define and understand various terms in analytical extraction.

Section I- Analytical Extraction Techniques (24 L+ 06 T) (2 Credit)

1. **Classical approach for aqueous extraction (6 L)**
   Introduction, Liquid-Liquid extraction (LLE) (Theory of LLE, selection of solvents, solvent extraction, problems with LLE process), purge and trap for volatile organics in aqueoussamples.

2. **Solid Phase Extraction (SPE) (6 L)**
   Introduction, Types of SPE media, SPE formats and apparatus, method for SPE operation, solvent selection, factors affecting SPE, selected methods of analysis for SPE, Automation and On-LineSPE

3. **Solid Phasemicro-extraction (6 L)**
   Introduction, theoretical considerations, experimental, Methods of analysis: SPMEGC, Methods of analysis: SPME-HPLC-MS, Automation of SPME, New development in micro extraction (liquid micro extraction, membranemicroextraction)

4. **Microwave Assisted Extraction (3 L)**
   Introduction, Instrumentation, Applications

5. **Supercritical Fluid Extraction (3 L)**
   Introduction,instrumentation, Applications.

Section II- Atomic spectroscopic analysis

(24 L+ 06 T) (2 Credit)

1. **Atomic Spectroscopy (12 L)**
   Theory, sources, burners, atomic emission spectra, atomic absorption spectra, effect of temperature on emission, absorption and fluorescence, electro thermal atomizers, Instrumentation for FES, radiation sources atomic absorption methods, instrumentation for AAS, spectral interferences, standard addition and internal standard method of analysis, comparison of atomic absorption and emission methods, inductively coupled plasma and direct current plasma emission spectroscopy, Cold vapour technique, Applications of AAS, AES and ICPAES, analysis of micronutrientslike Mo, B, Cu, Zn essential towards the healthy growth of crops, fruits, determination of these micronutrients from soils, plants and fruits.

2. **Atomic Mass Spectroscopy (6L)**
   Features of atomic mass spectroscopy, atomic weight in mass spectroscopy, mass to charge ratio, Types of atomic mass spectroscopy, mass spectrometers, transducer for mass spectroscopy, quadruple mass analyser, time of flight mass analyser, inductively coupled mass spectroscopy (ICPMS), Instrumentation for ICPMS, Atomic mass spectra and interferences, Applications of ICPMS.

3. **Atomic Fluorescence, Resonant Ionization and laser based-Enhanced Ionization (6L)**
   Atomic FluorescenceSpectroscopy (AFS): Atomic fluorescence, apparatus for AFS, EMR source for AFS, LASERS, Cells for AFS, Plasmas, Wavelength selection for AFS, Detectors for AFS, Theory of AFS,Resonant Ionization Spectroscopy, Laser-enhanced ionization spectroscopy.

References

1. Introduction to Instrumental Analysis, R. D. Broun, Mc. Graw Hill(1987)
2. Instrumental methods of chemical analysis, H. Willard, L.Merrit, J.A. Dean and F.A. Settle. Sixth edition CBS(1986)
3. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J. Holler, Saunders college publishing, 6thedition
4. Principles of Instrumental Analysis, Skog, Holler, Nieman, (Sixth Ed.)
5. Vogel's Textbook of Quantitative analysis 6thEd.
6. Modern analytical techniques in the pharmaceutical and bio analysis Dr. Istvan Bak (Book AvailableOnline).
7. Preparative chromatography Chrome Ed. book series, Raymond P. W. Scott (Book AvailableOnline).
8. Extraction technique in analytical science, John R. Dean, Wiley(2009)
9. Practical HPLC method Development, Snyder, Kirkiand, Glajch, Wiley IndiaPvt.Ltd.

Choice Based Credit System Syllabus
(2019 Pattern)

Class: M.Sc. II (SEM IV) **Subject**: Analytical Chemistry
Course Advances in Analytical Techniques **Course Code**: CHA-5402
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Program Outcomes with Course Outcomes

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	2	0	0	0	0	0	0	0
CO 2	0	3	0	0	2	0	0	0	0
CO 3	0	0	0	1	0	0	0	0	0
CO 4	0	0	0	0	0	0	0	0	0
CO 5	0	2	0	0	2	0	0	0	0
CO 6	0	0	0	0	0	0	0	0	0
CO 7	0	0	0	0	0	0	0	0	0

Program Outcome 1 (PO 1: Disciplinary Knowledge):
CO 1: Students will gain a comprehensive understanding of various methods of solvent extraction techniques. This knowledge is essential for mastering the foundational principles and practical applications of extraction methods in Analytical Chemistry, contributing to their overall disciplinary knowledge.
Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):
CO 3: Students will learn about the applications of atomic spectroscopy. This will involve critical thinking and problem-solving skills as they analyze real-world scenarios and make informed decisions on how to use atomic spectroscopy for elemental analysis in Analytical Chemistry.
CO 5: Students will be able to differentiate among various methods of analytical extraction, which requires critical thinking to select the most suitable method based on the characteristics of the sample and analytical goals.
CO 6: Students will develop the ability to apply and select a particular method of analysis for a sample to be analyzed, which involves problem-solving skills in choosing the appropriate analytical approach.
Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):
CO 3: The knowledge of the applications of atomic spectroscopy supports research-related skills, enabling students to explore the scientific applications of this technique in Analytical Chemistry.
Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):
CO 2: Understanding AAS, AFS, and AMS techniques involves knowledge that transcends the boundaries of Analytical Chemistry, as these techniques may have applications in various scientific disciplines.
Program Outcome 9 (PO 9: Advanced Research Skills):
CO 6: The ability to apply and select a particular method of analysis for a sample to be analyzed supports the development of advanced research skills, as it involves the application of analytical techniques in research scenarios.

CHA- 5403

Analytical methods for Analysis of fertilizers, detergents, Water, and Polymer, Paint and pigment

(48 L+ 12 T) (4 Credit)

Course Objectives:

The students are expected to learn,

1. Students are learning methods of element analysis.
2. The aerobic & anaerobic methods of water analysis.
3. Analysis of paints & pigments
4. Terms related to polymer chemistry
5. Analysis of Fertilizer, soap & detergent.
6. Solve numerical Problems on polymer chemistry.
7. Analysis and testing of polymer.

Course Outcomes:

CO1. Student should understand the methods of fertilizer analysis.
CO2. Student should understand the methods of water analysis.
CO3. Student should know methods of polymer, paint, pigment analysis.
CO4. Student should understand the polymerization process.
CO5. Student should be able to describe the chemical compositions of natural waters.
CO6. Student should able to describe the main source of water pollution and main types of pollutants.
CO7. Student should be able to identify the presence of harmful contaminants.

Section I- Analysis of fertilizers, soap and detergents, and waste water

(24 L+ 06 T) (2 Credit)

1. **Analysis of Fertilizers** **(6L)**

Sampling and sample preparation, water, total nitrogen: Kjeldahl's method, total nitrogen by reduced iron method, urea nitrogen, total Kjeldahl's nitrogen methods and spectrophotometric method,Ammonia nitrogen.

Phosphorus: total phosphorus, available and non-available, alkali metric ammonium molybdophosphate method, water soluble phosphorous, citrate insoluble phosphate, Potassium: potassium by sodium tetra phenyl borate method, flamephotometric methods.

2. **Analysis of soaps and detergents** **(8L)**

General scheme of analysis, sampling, alcohol soluble materials, moisture and volatile matter, active ingredient and equivalent combined SO_3

Tests for soaps: total fatty acids, fatty anhydride combined alkali, and anhydrous soap, Unsponified and unsaponifiable matter, Free alkali or free acid, titer test, Iodine value, saponificationvalue, free glycerol,

Tests for synthetic detergents: Unsulfonated or unsulfated matter,ester SO_3, Combined alcohols, total combined SO_3, Alkalinity, chlorides, silicate,phosphate, borates

UV spectroscopic analysis of detergents: Biodegradability of detergents, Determination of sodium alkyl benzene sulfonate, determination of sodium toluene sulfonate, determination of sodium xylene sulfonate, determination of germicides in soaps and detergents.

3. **Water pollution and analysis of polluted water (10 L)**

Water pollutants, waste water treatment: domestic waste water treatment, aerobic treatment process, anaerobic treatment process, industrial waste water treatment, The purpose of chemical analysis, sampling of water, pH of water, specific conductance, determination of acidity and alkalinity, chemical oxygen demand, biological oxygen demand, dissolved oxygen, turbidity, determination of aluminium, arsenic, boron, cadmium, calcium, carbon dioxide, chloride, residual chlorine, chlorine demand, chromium, cyanide, total hardness, iron, lead manganese, Zn, methane, nitrate, nitrite, ammonia, nitrogen, phenols, phosphates, silica, sulphate, sulfide, anionic detergents, tanninandlignin.

Section II

Polymer, Paint and Pigment analysis

(24 L+ 06 T) (2 Credit)

1. **Introduction to polymers (2L)**

Brief history to polymers, how polymers are made? classification of polymers

2. **Analysis and testing of polymers (10L)**
   a. **Chemical analysis ofpolymers:**X-ray diffraction analysis, thermal analysis, TGA, DTA.
   b. **Physical testing of polymers:**Mechanical properties, Fatigue testing, impact testing, tear resistance, hardness, abrasion resistance.
   c. **Thermal properties:** Softening temperature,flammability.
   d. **Optical properties:** transmittance, colour, gloss, haze andtransparency.
   e. **Electrical properties:** dielectric constant and loss factor, resistively, dielectric strength, electronicproperties.
   f. **Chemical properties:** resistance to solvents, vapour permeability, weathering.

3. **Measurement of molecular weight and size (4L)**

End group analysis, Colligative properties measurements, solution viscosity and Molecularsize.

4. **Analysis of Paints and Pigment (8L)**

Introduction, test on the total coating, water content, separation of pigment binder and thinner of solvent type coating, separation of pigment binder, and thinner oflatexpaints, Identification of the binder, Identification of polymer resins and oils, Identification of plasticizer, Analysis of the vehicle, Identification and Analysis of pigments,

Identification of inorganic pigments, Analysis of white and tinted pigments,outline of general procedure, HCL insoluble, Titanium dioxide, total lead, acid soluble Al and Fe, acid soluble calcium, total zinc, antimony oxide, total sulfate, total carbonate) analysis of colored pigments, Black pigments, other pigments, identification and analysis of thinners.

References

1. Standard methods of chemical analysis, F.J. Welcher volume 3,part-B
2. Standard methods of water and waste water analysis A. K.De.
3. Environmental Chemistry, A. K.De
4. Textbook of polymer science F.W.Billmeyer 3rdedition(1994).
5. Principles of polymer systems by F. Rodrigue, Tata Mc Graw Hill, NewDelhi.
6. Principles of polymer systems by P.J.Flory, Cornell University press, NewYork.
7. Polymer chemistry-an introduction Seymour-Carraher-Marcel Dekker. Inc. NewYork.
8. Polymer Science by V.R. Gowarikar, N.B. Vishvanathane, New Age publisher(1998)
9. Polymer Science by VasantGowarikar, Wiley Easteren New York(1998).
10. Principle of polymer science, Bahadhur and shastri, Narosapublishing

Choice Based Credit System Syllabus

(2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. II (SEM IV) **Subject**: Analytical Chemistry

Course: Analytical methods for Analysis of fertilizers, detergents, Water, and Polymer, Paint and pigment **Course Code**: CHA-5403

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	3	3	0	0	2	3	0	0	0
CO 3	3	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	2	0	0	3	0	0	0	0
CO 6	0	3	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0

Program Outcome 1 (PO 1: Disciplinary Knowledge):
CO 1: Students will understand the methods of fertilizer analysis, which is essential knowledge in the field of Analytical Chemistry, particularly for agricultural and environmentalapplications.
Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):
CO 2: Students will understand the methods of water analysis, enabling them to critically evaluate and solve problems related to the quality and safety of water resources.
CO 5: Students will be able to describe the chemical compositions of natural waters, demonstrating critical thinking in the context of water analysis.
CO 6: Students will describe the main source of water pollution and the main types of pollutants, showcasing critical thinking and problem-solving skills related to environmental issues.
Program Outcome 3 (PO 3: Social Competence):
CO 3: Students will know methods of polymer, paint, and pigment analysis, which can be applied in various industries, contributing to social competence by addressing quality and safety concerns in consumer products.
Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):
CO 4: Students will understand the polymerization process, which supports research-related skills by delving into the scientific aspects of polymer chemistry.
Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):
CO 5: The description of the chemical compositions of natural waters extends to trans-disciplinary knowledge, as it involves understanding water quality from both chemical and environmental perspectives.
Program Outcome 6 (PO 6: Personal and Professional Competence):
CO 2: The understanding of water analysis supports personal and professional competence, as water analysis is relevant in various professional settings.
Program Outcome 7 (PO 7: Effective Citizenship and Ethics):
CO 7: Students will be able to identify the presence of harmful contaminants, which is essential for effective citizenship and addressing ethical concerns related to public health and environmental protection.

CHA-5404: Method of Analysis and Applications
(48 L+ 12 T) (4 Credit)

Section I- Geochemical & alloy Analysis (24 L+ 06 T) (2 Credit)

Methods and Principle of analysis, reactions involved, flow sheet and procedures. Problems based on analysis of each material

Course Objectives:

The students are expected to learn,

1. Analysis of geological methods
2. Analysis of alloys
3. Analysis of body fluids
4. Student should be able to learn Immunoanalytical techniques.
5. Student should be able to learn Numerical problems based on geological materials.
6. Student should be able to learn Methods of soil analysis.
7. Student should be able to learn various types of methods of analysis for vitamins .

Course Outcomes:

CO1. To learn about immunological methods
CO2. To study about detective of abnormal levels of glucose, creatinine, uric acid in blood
CO3. Student should understand the methods of analysis of ore & alloys.
CO4. Student should understand the methods of soil analysis
CO5. Student should know the collection & storage of blood samples.
CO6. Student should solve the numerical based on all the topics included in this course.
CO7. Student should be able to apply the knowledge to solve the problems.

1. **Analysis of Geological materials** **(8 L)**
   Dolomite (For silicate, Mg and Ca content), Ilmenite (for silicate, Ti and Fe content), Monazite (for rare earth metals), Hematite and Magnetite (silicate and Fe content), Pyrolusite (for silicate and Mn content) and bauxite (for Al and Silicate content).

2. **Analysis of Alloys** **(8 L)**
   Stainless Steel (for Fe, Cr, Ni, Co, Cu, Mn, W, Si, V, Mo, Ti, Pb and Zr)Bronze and Gun metal (for Cu, Sn), , Brass (for Cu, Zn, Sn, Pb), Solder (for Pb and Sn),Nichrome (for Fe, Ni, Cr), Analysis of nickel Silver (Sn, pb, Cu, Fe, Ni and Zn) and Aluminium based alloys (Al,Mg,).

3. **Analysis of Soil** **(8 L)**
   i) Sampling, ii) Carbonate, Organic carbon, and organic matter, iii) Total nitrogen, ammonia and nitrates, iv) silica and total combined oxides of iron, aluminium, and titanium, V) Determination Ca, Mg, Na, K, phosphate, boron, Co, Cu, Zn, vii) Exchangeable cations vi) Cation exchange capacity,vii) chemical analysis as a measure ofsoilfertility.

Section II- Analysis of Body Fluid

(24 L+ 06 T) (2 Credit)

1. **Collection of Specimens** **(2 L)**
   Blood: Collection of Blood specimens, storage and preservation, Urine: Collection of Urine, physical characteristics of urea, preservation and storage, Faeces: Collection and preservation.

2. **Analysis of Blood and urine** **(6 L)**
   Determination of blood and plasma glucose by glucose oxidase method, Determination of urine for glucose, Determination of ketone bodies in blood, Oral Glucose tolerance test, Determination of serum creatinin, estimation of serum bilirubin, Estimation of serum cholesterol, determination of blood hemoglobin, Urate:determination of serum urate, Determination of urea in urine by direct colorimetry, Estimation of Na, K, Ca by flame photometry, inorganic phosphate by colorimetry.

3. **Determination of vitamins in body fluid** **(8L)**
   Classification of vitamins with example, Each vitamin must be explained with respect to functions, deficiency diseases, daily requirement and analytical method
   i) Retinol (determination of retinol and serum carotene in serum using TFA),Vitamin D3 (cholecalciferol), Vitamin E (Tocopherols, Determination of serum Tocopherols by spectrophotometry by dipyridyl method), Vitamin B1 (thiamine determination by flurometry), Vitamin B2 (riboflavin, Photofluorometric method), Vitamin B6 (Pyridoxine, Fluorometric determination of Xanthuric acid), Nicotinic acid and Niacin: determination by fluorometry, Ascorbic acid (vitamin C) Volumetric method using 2,6 dichlorophenol method,

4. **Immunoanalytical Techniques** **(6L)**
   Radioimmunoassay, its principle and applications, instrumentation for radio bioassay, clinical application of the radioimmunoassay of insulin, Estrogen and progesterone, receptor techniques of breast cancer. Enzyme linked immunosorbent assay (ELISA), Types of ELISA, principles, practicalaspects,applications.

5. **Organ function tests** **(2L)**
   Liver function tests and kidney function tests

References

1. Standard methods of chemical analysis, F.J. Welcher SixtEdition,.
2. Quantitative Inorganic Analysis including Elementary Instrumentalanalysis,I. Vogel, 3rd, ELBS, 1964.
3. Practical Clinical Biochemistry, Gowenlock, CBS published, 6thEd.
4. Biochemical methods of analysis, S. Sadasivam and A. Manickam, Narosa Publication

Choice Based Credit System Syllabus (2019 Pattern)

Class: M.Sc. II (SEM IV) **Subject**: Analytical Chemistry
Course: Method of Analysis and Applications **Course Code**: CHA-5404
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Program Outcomes with Course Outcomes

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	2	0	0	0	0	0	0	0	0
CO 2	0	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0

Justification of Mapping

PO 1: Disciplinary Knowledge:
CO 1: Students will learn about immunological methods, which are essential in the field of Analytical Chemistry for various applications, including medical and environmental analysis.
PO 2: Critical Thinking and Problem Solving:
CO 2: Students will study the detection of abnormal levels of glucose, creatinine, and uric acid in the blood. This requires critical thinking and problem-solving skills to interpret results and identify health issues.
PO 3: Social Competence:
CO 3: Students will understand the methods of analysis of ore and alloys. This knowledge contributes to social competence by addressing the needs of industries and metallurgical applications.
PO 4: Research-Related Skills and Scientific Temper:
CO 4: Students will understand the methods of soil analysis, which supports research-related skills in soil science and environmental research.
PO 5: Trans-Disciplinary Knowledge:
CO 5: Students will learn about the collection and storage of blood samples, which can have applications in various fields beyond Analytical Chemistry, including healthcare and forensic science.
PO 6: Personal and Professional Competence:
CO 6: Students will solve numerical problems related to all the topics included in this course, demonstrating personal and professional competence in analytical problem-solving.
PO 7: Effective Citizenship and Ethic:
CO 7: Students will be able to apply their knowledge to solve problems, contributing to effective citizenship by addressing analytical challenges and ethical concerns in various domains.

Practical Course III

CHA-5405

Analysis of pharmaceutical, food and Bio- analytical samples

(4 Credit)

Course Objectives:

1. Understand the principles of chromatography techniques.
2. Perform chromatographic separations effectively.
3. Understand the concept of carbohydrate analysis.
4. Gain proficiency in using the anthrone method for carbohydrate estimation.
5. Comprehend the principles of thiamine assay.
6. Develop practical skills in performing thiamine assays
7. Method Development of paracetamol drug.

Course Outcomes:

CO1. Students will explain the principles of thiamine assay.
CO2. Students will conduct a thiamine assay accurately.
CO3. Students will interpret assay results and calculate the thiamine concentration in the sample.
CO4. Understand the concept of carbohydrate analysis.
CO5. Gain proficiency in using the an throne method for carbohydrate estimation.
CO6. Method Development of paracetamol drug.
CO7. Analysis of caffeine drug

1. Determination of % purity of sodium benzoate.

2. Determination of % purity of lactic acid.

3. Determination of Dapson content in Dapson tablet

4. Determination of sulphamethoxazole content in co-trimoxazole tablet.

5. Identification of given unknown drug by using TLC- caffeine, Ibuprofen, quinine, salicylic acid and amino acid.

6. Chromatographic separation and identification of sugars/ amino acid

7. Estimation of total carbohydrates by anthrone method.

8. Determination of saponification value of oil.

9. Determination of iodine value of oil.

10. Assay of thiamine from given sample.

11. Analysis of quinine sulphate from given tablet by photoflurometry.

12. Estimation of tannin from given sample.

13. Analysis of caffeine from given tablet as per IP with respect to identification, assay.

14. Estimation of protein from food sample by Lowry method.

15. Analysis of paracetamol as per IP with respect to Identification, ash and assay.

16. Estimation of Fe from syrup sample by spectrophotometric method.

17. Estimation of HMF from honey.

18. Estimation of reducing sugar from food sample by spectrophotometry.

19. Determination of total acidity in juice.

20. Determination of glucose from glucon D by titration with Fehling method.

21. Moisture content in pharmaceutical/food sample by Karl Fischer titration method

22. Determination of adulterant in milk.

(Note: Minimum 18 experiments should be completed in this course)

References:

1. Lab manual: selected experiments of Pharmaceutical analysis, Anees A Siddiqui.
2. Experiments in chemistry, D.V.Jahagirdar.
3. Pharmacopeia of India
4. Vogel's textbook of quantitative chemical analysis, sixth Ed.
5. Environmental chemistry by A.K.De.
6. Biochemical methods, Sadashivam and Manickem, Narosa publication
7. Senior practical physical chemistry. B.D. Khosla and V.S. Garge (R. Chand and Co.Delhi)
8. Practical pharmaceutical chemistry 4^{th} Ed .Part -2, Beckette, Stenlake.
9. Practical clinical biochemistry, Harold Varley (4^{th} edition) , CBS publishers anddistributers, New Delhi-110002
10. Analytical Chemistry by Gary Christian, 6^{th} edition, 2008

Choice Based Credit System Syllabus

(2019 Pattern)

Class: M.Sc. II (SEM IV) **Subject**: Analytical Chemistry

Course: Analysis of pharmaceutical, food and Bio- analytical samples. **Course Code**: CHA-5405

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Program Outcomes with Course Outcomes

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	0	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	0	0	0	0
CO 7	0	0	0	0	0	0	0	0	0

PO 1: Disciplinary Knowledge:

CO 1: Students will explain the principles of the thiamine assay. This contributes to their disciplinary knowledge in the field of Analytical Chemistry, specifically in understanding the principles and methods of thiamine analysis.

PO 2: Critical Thinking and Problem Solving:

CO 2: Students will conduct a thiamine assay accurately, which involves critical thinking and problem-solving skills to ensure precise and reliable results.

PO 3: Social Competence:

CO 3: Students will interpret assay results and calculate the thiamine concentration in the sample. This enhances their social competence by addressing the needs of the food and pharmaceutical industries, which rely on accurate analysis of thiamine content.

PO 4: Research-Related Skills and Scientific Temper:

CO 4: Students will understand the concept of carbohydrate analysis, supporting research-related skills by providing a foundational understanding of carbohydrate analysis methods.

PO 5: Trans-Disciplinary Knowledge:

CO 5: Students will gain proficiency in using the anthrone method for carbohydrate estimation. This knowledge extends to trans-disciplinary knowledge, as carbohydrate analysisis relevant not only in chemistry but also in fields related to food science and nutrition.

Practical Course - IV

CHA-5406: Project work
(4 Credit)

Course Objectives:

1. To provide students with an opportunity to apply the knowledge and skills acquired during their academic coursework to real-world research.
2. To foster independent research capabilities and critical thinking.
3. To enable students to explore and contribute to a specific area of study.
4. To develop effective research, presentation, and scientific writing skills.
5. Presentation

Course Outcomes:

CO1. Apply Academic Knowledge: Apply the theoretical and practical knowledge acquired during their academic coursework to real-world research in the chosen area of study.
CO2. Demonstrate Research Skills: Demonstrate the ability to plan, conduct, and manage independent research, including experimental work, data collection, and analysis.
CO3. Critical Thinking: Develop and employ critical thinking skills to evaluate and solve problems encountered during the research process.
CO4. Contribute to Knowledge: Contribute to the existing body of knowledge in their chosen area of study by conducting original research and making meaningful findings.
CO5. Effective Communication: Effectively communicate their research methods.
CO6. Effectively communicate their results, and conclusions in both written and oral forms.
CO7. Effectively communicate their demonstrated in the presentation of a concise dissertation.

This is mandatory for every student to undertake the project work on selected area of study under the guidance of project coordinator. Student must carry out entire experimental work within the stipulated time and present it briefly in the form of the dissertation at the time evaluations.

Choice Based Credit System Syllabus

(2019 Pattern)

Class: M.Sc. II (SEM IV) **Subject**: Analytical Chemistry
Course: Project **Course Code**: CHA-5406
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Program Outcomes with Course Outcomes

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	2	2	2	2	0	0	0	0
CO 2	2	3	2	2	2	0	0	0	0
CO 3	2	2	3	2	2	0	0	0	0
CO 4	2	2	2	3	2	0	0	0	0
CO 5	2	2	2	2	3	0	0	0	0
CO 6	0	0	0	0	0	0	0	0	0
CO 7	0	0	0	0	0	0	0	0	0

PO 1: Apply Academic Knowledge:
CO 1: Students will apply the theoretical and practical knowledge acquired during their academic coursework to real-world research, demonstrating the practical application of academic knowledge.
PO 2: Demonstrate Research Skills:
CO 2: Students will demonstrate their research skills by planning, conducting, and managing independent research, including experimental work, data collection, and analysis.
PO 3: Critical Thinking:
CO 3: Critical thinking skills will be developed and employed to evaluate and solve problems encountered during the research process, enhancing their ability to think critically.
PO 4: Contribute to Knowledge:
CO 4: Students will contribute to the existing body of knowledge in their chosen area of study by conducting original research and making meaningful findings, thereby advancing knowledge.
PO 5: Effective Communication:
CO5: Effective communication skills will be demonstrated as students effectively communicate their research methods, results, and conclusions in written and oral forms, showcasing their ability to present a concise dissertation.