।। सा विद्या या विमुक्तये ।।

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

ACADEMIC (1-BOARD OF STUDIES) SECTION

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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील तृतीय वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१–२२ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, मा. विद्याशाखेने **दिनांक ३१ मे २०२१ रोजीच्या बैठकीतील केलेल्या शिफारशीप्रमाणे व दिनांक १२ जून २०२१ रोजी संपन्न झालेल्या ५१ व्या मा. विद्या परिषद बैठकीतील विषय क्र. २६/५१–२०२१**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील तृतीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१–२२ पासून लागू करण्यात येत आहेत.

1. B.Sc.-III Year-Biophysics
2. B.Sc.-III Year-Bioinformatics
3. B.Sc.-III Year-Biotechnology
4. B.Sc.-III Year-Biotechnology (Vocational)
5. B.Sc.-III Year-Botany
6. B.Sc.-III Year-Horticulture
7. B.Sc.-III Year-Agro Chemical Fertilizers
8. B.Sc.-III Year-Analytical Chemistry
9. B.Sc.-III Year-Biochemistry
10. B.Sc.-III Year-Chemistry
11. B.Sc.-III Year-Dyes & Drugs Chemistry
12. B.Sc.-III Year-Industrial Chemistry
13. B.C.A. (Bachelor of Computer Application)-III Year
14. B.I.T. (Bachelor of Information Technology)-III Year
15. B.Sc.-III Year-Computer Science
16. B.Sc.-III Year-Network Technology
17. B.Sc.-III Year-Computer Application (Optional)
18. B.Sc.-III Year-Computer Science (Optional)
19. B.Sc.-III Year-Information Technology (Optional)
20. B.Sc.-III Year-Software Engineering
21. B.Sc.-III Year-Dairy Science
22. B.Sc.-III Year-Electronics
23. B.Sc.-III Year-Environmental Science
24. B.Sc.-III Year-Fishery Science
25. B.Sc.-III Year-Geology
26. B. A./B.Sc.-III Year-Mathematics
27. B.Sc.-III Year-Microbiology
28. B.Sc.-III year Agricultural Microbiology
29. B.Sc.-III Year-Physics
30. B. A./B.Sc.-III Year Statistics
31. B.Sc.-III Year-Zoology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.: शैक्षणिक–१/परिपत्रक/पदवी–सीबीसीएस अभ्यासक्रम/२०२१–२२/७५

दिनांक : १२.०७.२०२१.

स्वाक्षरित
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :
१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.
७) अधीक्षक, परिक्षा विभाग विज्ञान व तंत्रज्ञान विद्याशाखा प्रस्तुत विद्यापीठ.

Swami Ramanand Teerth Marathwada University,Nanded

Faculty of Science and Technology

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN
Under Graduate (UG) Programme in Analytical Chemistry

w. e. f. Academic year 2021-22

SYLLABUS

B. Sc. THIRD YEAR [V & VI semester]
ANALYTICAL CHEMISTRY

Board of Studies in Chemistry
Swami Ramanand Teerth Marathwada University, Nanded

Analytical Chemistry

B. Sc. Third Year (Semester V & VI)

Total credits semester V and VI: 12

Sem.	Paper No.	Name of the Course	Instruction Hrs/ week	Total period	Internal Evaluation	Marks of Semester	Total Marks	Credits
V	DSEAC -V (Section A)	Modern Techniques of Chemical Analysis –I (P-XII)	03	45	10	40	50	02
	DECCAC- V (Section B)	Applied Analytical Chemistry –I (P-XIII) OR Fundamental concepts of Analytical Chemistry (P-XIII) (Elective)	03 03	45 45	10 10	40 40	50 50	02
	DSEAC P -IV (DECCAC V & VI) (Section A)	Practical's based on P-XII & P-XIV (P-XVI)	04	Practicals 08 08	05 05	20 20	25 25	01 01
		Practical's based on P- XIII (Elective)	04	Practicals 08	05	20	25	
	DSEAC -III SEC AC III	SEC AC- III Pharmaceutical Chemistry	02 + 01 = 03	45	25	25	50	(02)*
VI	DSEAC -VI (Section A)	Modern Techniques of Chemical Analysis-II (P-XIV) OR Physical Methods in Analytical Chemistry (P-XIV) (Elective)	03 03	45 45	10 10	40 40	50 50	02
	DSEAC -VI (Section b)	Applied Analytical Chemistry –II (P-XV)	03	45	10	40	50	02
	DSEAC P -V (Section B) (DSEAC –V & X VI (section B)	Practical's based on P- III & P-XV (P-XVII)	04	Practicals 08 08	05 05	20 20	25 25	01 01
		Practical's based on P-XIII & P-XV (P-XVII) (Elective)	04	08	05	20	25	
	DSEAC -IV SEC AC - IV	SEC AC- IV PESTICIDE CHEMISTRY	02 + 01 = 03	45	25	25	50	(02)*
Total credits semester V and VI:								12 (04)* = 16

DSEAC: Discipline Subject Elective in Analytical Chemistry, DSEAC P: Discipline Subject Elective in Analytical Chemistry Practical, ESE: End of Semester Examination, CA: Continuous Assessment, SECAC: Skill Enhancement Course in Analytical Chemistry.

Distribution of Credits: 80% of the total Marks for ESE and 20% for CA.

- CA of Marks 10: 10 Marks for test. - CA of 25 Marks: 15 Marks for Seminar & 10 Marks for test. Suggestions: The end examination of Skill Enhancement Course should be conducted on the separate day by

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -V Analytical Chemistry

Modern Techniques of Chemical Analysis –I (Credits: 02)

Paper Code DSEAC-V (Section A) Paper – XII

Periods: 45 Per Semester 03 per week Marks: 50

Unit – I. Infrared Spectroscopy: 12 Periods

Range of IR-radiation, Theory- Requirements for I R radiation absorption, Different normal modes of vibrations of atoms in a poly atomic molecule, Instrumentation and Experimental Technique. Application of IR spectroscopy.

Unit –II. 1H NMR Spectroscopy: 13 Periods

Theory of ^{1}H NMR, Instrumentation, Experimental technique, NMR spectra, Number of signals equivalent and nonequivalent protons, Chemical Shift, Measurement of Chemical Shift, Factors affecting chemical shift, Spin-spin coupling, functional groups and chemical shifts, Applications of 1HNMR spectra in structure determination and identification of compounds.

Unit – III. Mass Spectrometry: 12 Periods

Theory, Instrumentation, Recording of mass spectrum, Resolution of mass spectrometer, Types of ions produced in a mass spectrometer, interpretation of mass spectra, Applications of mass spectrometry.

Unit – IV. Fluorescence Spectroscopy: 08 Periods

Theory, Relation between fluorescence intensity and concentration, Single and Double beam filter fluorometers, Applications.

Objective(s)	To acquire fundamental knowledge about IR, ^{1}H NMR, Mass, & Fluorescence spectroscopic techniques
Course Outcome(s)	
CO- I	Learn basic knowledge of IR spectroscopy & operation of IR instrument.
CO-II	Get basic knowledge of ^{1}H NMR its operation and applications.
CO-III	Understand fundamental knowledge of Mass spectrometry and applications.
CO-IV	Familiar with fluorometer and its applications

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science
B.Sc. III (Third) Year, Semester -V Analytical Chemistry
Applied Analytical Chemistry –I (Credits: 02)
Paper Code DSEAC-V (Section B) Paper – XIII

Periods: 45 Per Semester 03 per week Marks: 50

Unit – I. Environmental Analysis (Air and water): 12 Periods

a). Analysis of Air: Introduction, composition of atmospheric air, sampling of air, Determination of i) particulate matter suspended and settled ii) Sulphur dioxide iii) Nitrogen dioxide iv) Carbon mono and dioxide as pollutants.

b). Analysis of Water: Introduction to potable water quality standards, objectives of water analysis. Methods of measurement of water quality parameters: Physical parameters pH, conductivity, total dissolved solids. Determination of chemical parameters – Temporary and Permanent Hardness, Dissolved oxygen, Chemical Oxygen Demand and Biochemical Oxygen Demand.

Unit – II. Environmental Analysis (Industrial Effluents & Soil) 12 Periods

a). Analysis of Industrial Effluents: Introduction, definition, preliminary treatment of industrial effluent sample, estimation of toxic metals like Hg & Zn in industrial effluents.

b). Analysis of Soil: Introduction, Methods of soil sampling, Determination of (i) Bulk density (ii) specific gravity (iii) water holding capacity (iv) moisture content (v) Loss on ignition (vi) soil pH. Chemical Analysis of Soil: Determination of (i) Total nitrogen, (ii) Nitrate Nitrogen (iii) organic matter (iv) Potassium and Sodium.

Unit – III. Analysis of Food and Food Products: 16 Periods

Composition and Analysis of

i) **Milk:** Introduction, definition, general composition of milk. Determination of specific gravity, Total solids, fat, Protein, Lactose and Acidity
ii) **Wheat flour:** Introduction, types of wheat flour, general composition of wheat flour. Determination of moisture, ash fat, protein, fiber, acidity, pH & starch.
iii) **Fish:** Introduction, assessment of raw fish for its spoilage, Chemical methods for assessment of spoilage Determination of moisture, total fat, ash, chloride, Nitrogen and total phosphorus.
iv) **Honey:** Introduction, definition determination of total solids, moisture, ash, free acid pH and glucose.

Unit – IV. Analysis of Cosmetics: 05 Periods

Introduction to cosmetics, definition, General characteristics, composition and analysis in outline of the following (i) Face Powders (ii) Hair dyes

Objective(s)	To understand the students basic knowledge of Environment, food & food products, soil and cosmetic analysis.
Course Outcome(s)	
CO- I	Understand the concepts of environmental air & water pollution analysis.
CO-II	Aware the knowledge of industrial effluents, soil pollution and its analysis.
CO-III	Illustrate the physico-chemical analysis of food & food products.
CO-IV	Aware the composition, advantages & disadvantages of cosmetics.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -V Analytical Chemistry

Fundamentals of Analytical Chemistry –I (Credits: 02)

Paper Code DSEAC-V (Section B) Paper – XIII

Elective

Periods: 45 Per Semester 03 per week Marks: 50

Unit I. Introduction to QA/QC **12 Periods**

Laboratory quality management, Laboratory Accreditation, Validation of laboratory tests, Key Elements of a QA/QC Program, proficiency testing, quality control testing, quality assurance monitoring, procedure manual, laboratory reports, laboratory records, laboratory security, Personnel and Training, Validation of Analytical Procedures, Equipment, Standard Operating Procedures, Study protocols, The Final report, Archiving, Storage and Retrieval, Inspection and Compliance. Regulatory aspects of quality control, Quality 63 assurance and quality management ISO, WHO and US certification.

Unit II. Quality Assurance Standards **08 Periods**

Quality Assurance Standards for Forensic DNA Testing Laboratories: References, Scope, Definitions, Quality Assurance Program, Organization and Management Personnel, Facilities, Evidence Control, Validation, Analytical Procedures, Equipment Calibration and Maintenance, Reports.

Unit III. Basic concepts of Statistics and data analysis **13 Periods**

Basic definitions and applications of statistics, sampling: Representative sample, sample size, sampling bias and sampling techniques. Data collection and presentation: Types of data, methods of collection of primary and secondary data. Methods of data presentation-graphical representation by histogram, polygon, ogive curves and pie diagram. Measures of central tendency: mean, median and mode; measures of dispersion: range, mean deviation, standard deviation, variance, quartile, standard error and coefficient of variation; correlation and regression: Positive and negative correlation and calculation of Karl-Pearsons coefficient of correlation, skewness and kurtosis.

Unit IV. Probability and Test of hypothesis **12 Periods**

Introduction to probability theory, various definitions of probability, Basic terms: random experiments, event, trial, sample space, independent and mutually exclusive events; conditional probability, Addition and multiplication theorem, Baye's theorem, likelihood ratio and discriminating power. Distribution of data: normal, binomial and Poisson distribution. Test of hypothesis: introduction and concepts; test for small and large sample: Z-test, t-test, chisquare test, F-test and ANOVA.

Objective(s)	To enable the students acquire the fundamental knowledge in QA/QC.
Course Outcome(s)	
CO- I	Create awareness of behavior in laboratory.
CO-II	General awareness about quality standards in analytical chemistry.
CO-III	Learn the statistical concepts and data interpretations.
CO-IV	Familiar the students with basic concepts, principles of sampling and hypothesis Testing.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -V Analytical Chemistry

LABORATORY COURSE – IV (Credits: 02)

Paper Code DECCAC P – IV

DSEAC – V & VI (Section A) Paper – XVI

Periods: 120 Per Semester 04 per week Marks: 50

Note: - At least 16 experiments' to be completed.

1. Analysis of ores & Soil.
    1. Estimation of Na/ K by flame photometer in a solution/ sample.
    2. Estimation of aluminum in bauxite gravimetrically.
    3. Determination of calcium in dolomite by flame photometer.
    4. Electrogravimetric determination of copper in an ore.
    5. Polarographic determination of trace quantity of lead/ Cadmium/ Zinc in sample solution.
    6. Determination of Silver in an alloy by Volhard's method
    7. Determination of Silica in soil.
    8. Determination of magnesium in soil.
    9. Determination of soil pH.
2. Analysis of biochemical's.
    1. Estimation of Na/ K in blood serum by flame photometer.
    2. Determine of blood sugar by Folin –Wu-Method.
    3. Mercurometric determination of blood or Urine chloride.
    4. Determination of bicarbonate in blood using back titration.
    5. Spectrophotometric determination of inorganic phosphorus in human serum or Urine.
    6. Testing for chemical toxicity using bacteria.
    7. Determination of SO2 in sugar (Ref: System of Technical control for cane sugar factories in India – R. M. Verma Sugar Technologists Assoc. of India , Kanpur)
    8. Spectrophotometric determination of lead on leaves using solvent extraction.
    9. Spectrophotometric determination of manganese and chromium in mixture.
3. Chromatographic Techniques
    1. Determination of Capacity of cation exchange resin.

2. Determination of Capacity of anion exchange resin.
3. Separation of cobalt and nickel on an anion exchange resin and their subsequent determination by direct back EDTA titration.
4. Paper/Thin layer chromatography separation of metals/ amino acids / Sugars from a mixture.
5. Chromatographic separation of plant leaf pigments.
6. Determination of magnesium and Zinc in a mixture/ Zinc in pharmaceutical preparations by ion exchange separation and complexometric titration.
7. Separation of cadmium and zinc on an anion exchanger and their subsequent determination by EDTA titration.

4. Analysis of water
    1. Potentiometeric determination of fluoride in drinking water/ river water using Fluoride- ion selective electrode.
    2. Determination of available chlorine in bleaching powder volumetrically using an external Indicator.
    3. Micro scale quantitative Analysis of Hard water samples using an indirect potassium permanganate Redox titration.
5. Elemental Analysis
    1. Determination of concentration of ferrous ion by potentiometric titration.
    2. Determination of antimony by titration with iodine.
    3. Iodometric determination of copper.
    4. Estimation of ferrous and ferric iron in a mixture.
    5. Determination of copper and Nickel in a mixture.

Objective(s)	To enable the students to handle some instruments like, Flame Photometer, Potentiometer etc. and some basic laboratory operations like volumetric analysis and separation by ion exchange chromatography.
Course Outcome(s)	
	Students can able to handle instruments and perform basic procedures like volumetric analysis and ion exchange chromatography.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -V Analytical Chemistry

Laborotary Course IV (Credits: 02)

Paper Code DECCAC P – IV DSEAC – V & VI (Section A)) Paper – XVI

Elective

Periods: 120 Per Semester 04 per week Marks: 50

Note: - At least 16 experiments' to be completed.

1. Determination of COD, BOD and dissolved oxygen from waste water sample.
2. Separate and estimate the amount of cadmium and zinc using ion exchange resin.
3. Estimation of Nitrogen from given sample of fertilizer by Kejaldal method.
4. Estimation of chloride from food sample by Volhard titration method.
5. Determination of sodium carbonate in washing soda.
6. Determination of volume strength of commercial hydrogen peroxide using KMnO4
7. Moisture content in pharmaceutical/food sample by Karl-fisher titration method.
8. Estimation of pesticide residue by TLC method
9. Estimation of Mg from given sample of talcum powder.
10. Estimation of alcohol in the given sample by diffusion oxidation method
11. Determination of boric acid by conductometric method.
12. Determination of commercial vinegar by potentiometric titration and its confirmation by conductometric method.
13. Determination of molecular weight of high polymer by viscosity measurement /turbidometric method
14. Determine the amount of phosphate from given sample of fertilizer/ detergent using spectrophotometric method.
15. Estimation of Cu (II) and Fe (III) by spectrophotometric method using EDTA .
16. Estimate the reducing sugar by 3, 5 dinitrosalicylic acid in the given food sample by Spectrophotometric method.
17. Determination of protein by biureate method using by Spectrophotometric method
18. Determine the percentage composition of the mixture by refractometer.
19. To determine equivalent conductance at infinite dilution of strong electrolyte (any one from KCl, NaCl, KNO3 and HCl).
20. To determine dissociation constant of weak acid conductometrically.

Objective(s)	To enable the students to handle some instruments like, conductometer, Potentiometer, spectrophotometer etc. and some basic procedures for the analysis of food and fertilizers.
Course Outcome(s)	
	Students can able to handle instruments and perform basic procedures for analysis of food and fertilizers.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -V Analytical Chemistry

Skill Enhancement Course SEC AC III (Credits: 02)

PHARMACEUTICAL CHEMISTRY

Paper Code DSEAC III
Elective

Periods: 45 Per Semester 03 per week Marks: 50

Drugs & Pharmaceuticals, Drug discovery, design and development, Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, antiinflammatory agents (Aspirin, paracetamol, ibuprofen), antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryltrinitrate), antilaprosy (Dapsone), HIV- AIDS related drugs (AZT- Zidovudine). Fermentation Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Practicals (any two)

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).
3. Preparation of paracetamol.
4. Analysis of vitamin C.

Objective(s)	To train the students for basic knowledge of synthetic methods, advantages & disadvantages of drugs and vitamins.
Course Outcome(s)	
Course Outcome	Understand the preparations methods of different drugs, applications and its analysis.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -VI Analytical Chemistry

Modern Techniques of Chemical Analysis –II (Credits: 02)

Paper Code DSEAC-VI (Section A) Paper – XIV

Periods: 45 Per Semester 03 per week Marks: 50

Unit- I. Electro analytical Techniques -1 13 Periods

Conductometry: Conductance, specific conductance, Equivalent conductance, molecular conductance, Effect of dilution, measurement of conductance- conductivity cell, wheat stone bridge apparatus. Conduct metric Titrations, apparatus for conductometric titrations, Types of conductometric titrations -Acid base, Precipitation and Redox titrations.

Potentiometry: Electrode Potential, Standard electrode potential, Nernst equation, EMF of an electrolytic cell, reference, indicator and ion selective electrodes. Theory of potentiometric titrations, Types of potentiometric titrations- Acid base, Redox and precipitation titrations.

Unit- II. Electro analytical Techniques -2 14Periods

Polarography: Principle of DC polarography, polarogram, Limiting current, Residual current, Migration current, Diffusion Current, IlKovic equation, Kinetic Current, Decomposition potential, half wave potential. Instrumentation, dropping mercury electrode, dissolved oxygen electrode. Analytical applications of polarography.

Amperometry: Theory of amperometric titrations, typical titration curves, Apparatus with rotating Platinum microelectrode and applications.

Unit III. Chromatographic Techniques – 1 06 Periods

Ion Exchange Chromatography: Principle, ion exchange resins & their types- cation exchange resins anion exchange resins, ion exchange reactions, ion exchange equilibria, properties of ion exchange resins, ion exchange capacity, Techniques- Batch & Column method and applications.

Unit IV. Chromatographic Techniques -2 & Computers in Analytical Chemistry: 12 Periods

Size Exclusion chromatography: Principle Gel-materials, Technique, instrumentation and applications.

Super Critical Fluid Chromatography: Principle, instrumentation and applications

Computers in Analytical Chemistry: Role of computers and Microprocessors in Analytical Chemistry

Objective(s)	To familiarize the students with some electroanalytical and chromatographic techniques.
Course Outcome(s)	
CO- I	Learn the basic principle and working of conductometry and potentiometry.
CO-II	Understand theoretical principles and working in polarography and amperometry.
CO-III	Students acquire the knowledge of principle, experimental techniques and application of chromatographic techniques and use of computers in analytical chemistry.
CO-IV	

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -VI Analytical Chemistry

Physical Methods in Analytical Chemistry (Credits: 02)

Paper Code DSEAC-VI (Section A) Paper – XIV

(Elective)

Periods: 45 Per Semester 03 per week Marks: 50

Unit I: Microscopy **10 Periods**

Principle, working and forensic applications of different types of microscopes, light, Fluorescence, Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent microscopy, Infra-red microscopy, Laser scanning co focal Microscopy, Differential interference microscopy, Atomic force microscope.

Unit II Electrophoresis **12 Periods**

Theory and general principles, various factors affecting electrophoresis, low and high voltage electrophoresis, horizontal and vertical Electrophoresis. Electrophoretic techniques – Sodium dodecyl sulphate (SDS), Agarose Gel Electrophoresis (AGE), Polyacrylamide Gel Electrophoresis (PAGE), 2-D gel electrophoresis, Western blotting, Iso-electric focusing (IEF), Gel immuno-diffusion, complement fixation, radio immuno assay (RIA), ELISA, and 30 fluorescence immunoassay for detection of viruses including Hepatitis, Influenza, HIV and others, Immuno-assays: SRID, ELISA-PCR, Immuno fluorescence and their applications.

Unit III Centrifugation **10 Periods**

Differential centrifugation, Density gradient centrifugation: Rate Zonal, Isopycnic. Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications, Ultra centrifugation.

Unit IV: Spectroscopy **13 Periods**

Ultra violet and visible spectrophotometry: Types of sources, wavelength selection, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection, Fluorescence and phosphorescence spectrophotometry, Atomic absorption spectrometry, Atomic Emission spectrometer, X-ray spectroscopy, Infrared spectrophotometry, Raman Spectroscopy, Mass spectrophotometer, NMR and ESR spectroscopy, Molecular structure determination using X-ray diffraction, surface plasma resonance methods and their applications in forensic biology

Objective(s)	Aim of this paper is to explore the students with fundamental knowledge of physical methods in analytical chemistry.
Course Outcome(s)	
CO- I	Understand the basic principle, working and forensic applications of different types of microscopes.
CO-II	Crate general awareness about principle and applications of electrophoresis.
CO-III	Know the types and applications of centrifugation.
CO-IV	Understand primary information about principle and applications of spectroscopy.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -VI Analytical Chemistry

Applied Analytical Chemistry –II (Credits: 02)

Paper Code DSEAC-VI (Section B) Paper – XV

Periods: 45 Per Semester 03 per week Marks: 50

Unit – I. Pharmaceutical Analysis: 11Periods

Introduction, definition, sources of drug, pharmacopeia standards, classification of drugs on the basis of their effects, therapeutic action and structure. Definition and analysis of followings classes of drugs with one specific example of each: (i) Antiseptics and Disinfectants (ii) Analgesics (iii) Antipyretics (iv) Antibiotics.

Unit – II. Clinical Analysis 12 Periods

Introduction, composition of Blood, Non cellular/ plasma and cellular components, Normal range of concentration of important constituents, collection and preservation of blood for plasma, serum, glucose and CO2 analysis. Estimation of sodium, potassium, calcium, and bicarbonate, Blood glucose, Blood urea.

Unit – III. Separation by Solvent Extraction: 10 Periods

Introduction, theoretical principles – Nernst distribution law, Distribution constant, Distribution ratio, Efficiency of extraction, Percentage extraction, amount of solute extracted and left Unextracted, Sequence of extraction process, Extraction equilibria, factors favoring extraction, Techniques of extraction, Analytical applications.

Unit – IV. Analysis of fuels: 12Periods

Introduction, definition and classification of fuels, solid fuels, liquid fuels and gaseous fuels. Calorific value of fuels, Gross and Net calorific value, Determination of calorific value by Bomb Calorimeter, Proximate analysis of coal- moisture, volatile matter, ash, fixed carbon & their significance.

Flash, fire and aniline points of liquid fuels, their determination and significance.

Objective(s)	Aim of this paper is to explore the students with knowledge of pharmaceutical, clinical, fuel analysis and solvent extraction.
Course Outcome(s)	
CO- I	Understand the basic knowledge of drugs and its applications.
CO-II	Acquire the knowledge of blood composition and clinical analysis.
CO-III	Able to understand theoretical principles and applications of solvent extraction.
CO-IV	Learn the basic classification of fuels and its applications.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -VI Analytical Chemistry

LABORATORY COURSE – IV (Credits: 02)

Paper Code DECCAC P – V DSEAC – V & VI (Section B) Paper – XVI

Periods: 120 Per Semester 04 per week Marks: 50

Note: - At least 16 experiments' to be completed.

1. Environmental Analysis.

    1. Colorimetric estimation of traces of nitrogen in the sample of water using Nessler's reagent.
    2. Determination of dissolved oxygen in water by Winkler's method.
    3. Determination of nitrate nitrogen/ nitrite nitrogen/ phosphate in a sample of water by colorimetry.
    4. Determination of total hardness, calcium hardness and magnesium hardness of a water sample.
    5. Determination of chemical oxygen demand (C.O.D) of a waste water sample.
    6. Estimation of carbon/ organic matter in a soil sample by chromic acid digestion.

2. Food & Food product analysis.

    1. Determination of nitrogen in wheat flour.
    2. Estimation of lipids in egg yolk.
    3. Estimation of protein in milk by formal titration/ casein nitrogen.
    4. Analysis of milk for its lactose/ total solid/
    5. Determination of ascorbic acid in fruit juices/ citrus fruits.
    6. Determination of total acidity, fixed acidity and volatile acidity in pickles / titratable acidity in fruits/ fruits juices.14
    7. Determination of sodium bicarbonate in carbonated drinks/ soda water/ soft drinks and determination of caffeine in cola drinks/ carbonated beverages.
    8. Determination of water extractives and tannin in a Tea Coffee sample.
    9. Determination of ether extractives and caffeine in tea/ Coffee samples.

10. Determination of vanillin in vanilla extract/ food sample.

11. Determination of iron content in foods by spectrophotometry.

12. Isolation of piperine from black pepper and its determination as crude piperine.

13. Determination of Carbon dioxide in carbonated beverages.

3. Pharmaceutical, Clinical & Cosmetics analysis:

1. Determination of glucose in honey by Wilstatter's method.
2. Analysis of acetyl salicylic acid.
3. Estimation of micro nutrients Zinc/Copper/ Maganese in a soil sample.
4. Determination of acid value of rosin.
5. Determination of pH of Hair shampoos.
6. Assay of isomiazide.
7. Ultraviolet spectrophotometric determination of Asprin, Penacetin, and caffeine in APC tablets using solvent extraction.
8. Estimation of blood glucose.
9. Estimation of serum bicarbonate.
10. Estimation of blood urea.

4. Fuel Analysis:

1. Determination of moisture in coal
2. Determination of Ash in coal.

Objective(s)	To familiarize the students with the practically analysis of environmental composition, food and food products, pharmaceutical analysis including cosmetics and fuels.
Course Outcome(s)	
	Students become aware of analysis of environmental composition, food and food products, pharmaceutical analysis including cosmetics and fuels.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -VI Analytical Chemistry

LABORATORY COURSE – IV (Credits: 02)

Paper Code DECCAC P – V DSEAC – V & VI (Section B) Paper – XVI

Elective

Periods: 120 Per Semester 04 per week Marks: 50

Note: - At least 16 experiments' to be completed.

1. Calibration of weight and calculation of errors in it.
2. Calibration of burette, pipettes and Standard Flasks.
3. Estimation of polyphenols present in tea sample.
4. Ash content of milk powder,
5. Estimation of chlorine in bleaching powder
6. Determine Empirical formula using mole ratio method.
7. Determination of Phosphoric acid content of soft drink
8. Determine % purity of commercial sample of NaOH
9. To separate chlorophyll from green leaves by paper chrpmatography.
10. Analysis of the given sample of antacid using standard HCl and NaOH solutions.
11. Estimation of aspirin from aspirin tablets.
12. Determination of percentage purity of common salt using a cation exchanger.
13. Determination of potassium content of a commercial salt sample by flame photometry.
14. Determination of acetic acid content of a vinegar sample by potentiometric titration with sodium hydroxide using quinhydrone.
15. Determination of Cr (VI) in the given solution as dichromate by the method of least squares spectrophotometrically
16. Determination of empirical formula of a complex between Fe+3 and 5-sulphosalicylic acids by Job's method colorimetrically.
17. Determine the concentration of KCl solution by titrating it with standard solution of $AgNO_3$ conductometrically.
18. Determination of acid value of rosin.
19. Determination of pH of Hair shampoos.
20. Spectrophotometric determination of lead on leaves using solvent extraction.
21. Spectrophotometric determination of manganese and chromium in mixture.

Objective(s)	To familiarize the students with the practically to calibration of apparatus, some estimation, separation by chromatography etc.
Course Outcome(s)	
	Students get practical knowledge of calibration, chromatography and estimations by volumetric analysis.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. III (Third) Year, Semester -VI Analytical Chemistry

Skill Enhancement Course SEC AC – IV (Credits: 02)

Pesticide Chemistry

Paper Code DSEAC III

Elective

Periods: 45 Per Semester 03 per week Marks: 50

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organ chlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Practicals (Any two)

1 To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.

2 Preparation of simple organophosphates, phosphonates and thiophosphates.

3. Preparation of Bordeaux mixture.

Objective(s)	To train the students for basic knowledge of pesticide chemistry.
Course Outcome(s)	
CO	Understand the synthetic procedures and analysis of pesticides.

Recommended Books:

1. Instrumental Methods of Chemical Analysis. (1989): Chatwal G and Anand, S. Himalaya Publishing House, Mumbai.
2. Instrumental Methods of Analysis 6th Edition. (1986): H.H. Willard, L.L. Merritt Jr. and others.CBS Publishers and Distributors.
3. Spectroscopy. (Vol. 1): Edited by B.B. Straughan and S. Walker. Chapman and HallLtd.
4. Spectroscopy: B.P. Straughan and S. Walker.
5. Fundamentals of analytical Chemistry 7th Edition – Douglas A Skoog, Donald M West and Holler Harcourt College Pub
6. Principles of instrumental analysis: D.A Skoog and D. M. West sauder's college pub
7. Analytical chemistry: Gary D. Christain 4th Edition John Wiley and Sons New York
8. Spectrometric Identification of Organic Compounds: Silverstain, Bessler and others
9. Spectroscopic Methods in Organic Chemistry: D. H. Williams and Ian Fleaming
10. Analytical Chemistry - H, Kaur, PragatiPrakashan Meerut (for Fuel & Soil Analysis)
11. Analytical Chemistry - Dr. Alka K. Gupta, PragatiPrakashan Meerut (for Fuel & SoilAnalysis)

12. Principles and practice of Analytical Chemistry – F. W. Fi Field & D. Kealey.
13. Chromotography – D. R. Brown Ivy publishers, New Delhi.
14. Gel Electrophoresis of Proteins- A Practical Approach: Hanes.
15. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons. Inc., New York.
16. Biophysical chemistry Principles and techniques: AvinashUpadhyay, KakoliUpadhyay and NirmalenduNath.
17. A Biologists Guide to Principles and Techniques of Practical Biochemistry. (1975): Williams, B.L. and Wilson, K.
18. Gel Electrophoresis of Proteins- A Practical Approach: Hanes.
19. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons. Inc., New York.
20. Text Book of Biochemistry: West and Tood/ Lehninger.
21. Environmental analysis: G. R. Chatawal MC Mehra, M satake and other – Amol Publications, New Delhi
22. Analytical Aagricultural Chemistry : SL Chopra and J. S. Kanwar Kalyani Publishers, Ludhiana
23. Chemistry of the Soil: Edited by Firman E. Bear 2nd Edition Americalchem.. Soc. Monograph Series Oxfor& IBHPub
24. 14. A text Book of Experiments & Calculations in Engineering Chemistry S. S. Dara S. Chand and Co.
25. Elements of Environmental Chemistry: H. V. Jadhav, Himalaya Publishing House.
26. Experiments in general Chemistry: C. N. Rao and U. C. Agrawala, 4th Edition Affilated East – West Press.
27. Pearsons Chemical Analysis of Foods: Harold Egan, Ronald S. Kirk and Ronald sawyer, 8th Edition, Churchill Livingstone.
28. . Chemical analysis of food and food products: M.B. Jacob.
29. Food analyses – Lab Experiments: Melon and Pomerazu.
30. Introduction to Chromagraphy: V. K. Srivastava and K Krishna S. Chand and Co.
31. Polarographic methods in Analytical Chemistry: M.G. Arora, Anmol Publications, New Delhi.
32. Cremlyn, R. Pesticides. Preparation and Modes of Action, John Wiley & Sons, New York, 1978.

Important Notes:-

1. Visit to the National research Institutes for example NCL, NPL, I I C T, BARC, SIC etc is recommended.
3 Educational tour is recommended.
4 Aims and objectives of all the experiments are well defined.