RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS)

LATUR – 413512

DEPARTMENT OF ANALYTICAL CHEMISTRY

Syllabus

B.Sc. (Second Year) Analytical Chemistry
CBCS Pattern

(III & IV Semester)

With Effect From 2018-2019

Rajarshi Shahu Mahavidyalaya, Latur
B.Sc. II Year
Analytical Chemistry
Course Structure, Semester-III (w.e.f.2018-19)

Paper	Course Code	COURSE	Periods / Week	Total Periods	Marks	Credits
V	U-ANC-355	Inorganic and Organic Analysis-V	03	45	50	02
VI	U-ANC-356	Instrumental Methods of Chemical Analysis-VI	03	45	50	02
III	U-ANC-357	Analytical Chemistry Laboratory Course – III	03	45	50	02
IV	U-ANC-358	Analytical Chemistry Laboratory Course – IV	03	45	50	02
	SECAC-I	Glass, Pharmaceutical and Forensic Analysis	03	45	50	02
			Total		**250**	**10**

B.Sc. II Year
Analytical Chemistry
Course Structure, Semester-IV (w.e.f.2018-19)

Paper	Course Code	COURSE	Periods/ Week	Total Periods	Marks	Credits
VII	U-ANC-455	Analysis of Industrial Products and Quality Concepts-VII	03	45	50	02
VIII	U-ANC-456	Radiochemical, Thermal, Optical and Chromatographic Methods-VIII	03	45	50	02
V	U-ANC-457	Analytical Chemistry Laboratory Course –V	03	45	50	02
VI	U-ANC-458	Analytical Chemistry Laboratory Course – VI	03	45	50	02
	SECAC-II	Food Processing, Preservation and Adulteration	03	45	50	02
			Total		**250**	**10**

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(Autonomous)
Faculty of Science
B.Sc. II (Second) Year; Semester - III (w.e.f.2018-19)
Analytical Chemistry; Paper - V
"Inorganic and Organic Analysis"
Paper Code: U-ANC-355

Periods: 45/semester **Marks: 50**
03 per week **Credits : 02**

Learning Objective :

1.To understand the various Inorganic and Organic Analysis techniques.
2. To familiarize the students with Inorganic salt, plant, elemental & metallurgical Analysis

Course Outcome:

1. Inorganic and Organic analysis techniques are inculcated in students
2.Students acquired sound knowledge regarding inorganic salt, plant, elemental and metallurgical analysis.

Unit – I Inorganic Salt Analysis: **15 Periods**

1.1 Chemical analysis, types of Qualitative inorganic analysis. Classification of anions & cations into groups. Group reagents & reactions for cations only. Role of complexation in identification of cations.

Spot – Test Analysis: Definition, Advantages, and spot test procedures.

1.2 Plant/Medicinal Plant Analysis:.Sampling, processing and storage of plant samples. Analytical methods of plants: Sample ashing – Digestion procedures – Dry Ashing, Dry ashing with magnesium nitrate. Wet Digestion – Diacid, Triacid Diagestion, Digestion with H_2SO_4+H_2O_2 & HNO_3 – Microwave, Estimation of N, P, K & S

Unit –II Semi–micro Determination of Elements in the Organic Compounds :
12 Periods

2.1 Semi micro determination of Carbon, Hydrogen, Sulphur, Nitrogen and Halogens in the Organic Compounds.

2.2 Functional Group Analysis: Estimation of the following functional groups in the organic Compounds: Hydroxy (phenolic only), carbonyl, ester, Nitro, Amino and Carboxylic acid.

Unit – III Metallurgical Analysis : **08 Periods**

3.1 Estimation of main constituents in the following ores- Haematite, Pyrolusite, Bauxite and Lime stone.

Unit – IV Analysis of Metals and Alloys: **10 Periods**

4.1 Analysis of Copper, Aluminum metals for their percentage purity.

4.2 Composition and analysis of following alloys- Brass and Solder.

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(Autonomous) Faculty of Science
B.Sc. II (Second) Year; Semester - III (w.e.f.2018-19)
Analytical Chemistry; Paper - VI
"Instrumental Methods of Chemical Analysis"
Paper Code – U-ANC-356

Periods: 45/semester **Marks: 50**
03 per week **Credits : 02**

Learning Objective:

1. Introduce the students to instrumental methods of Chemical Analysis.
2. Understand spectroscopic methods namely visible, AAS & FES and Electron Microscopic methods – SEM, TEM & AFM.

Course Outcome:

Students become familiar with instrumental methods of Chemical analysis such as visible, atomic absorption and flame emission spectroscopic techniques and with microscopic methods such as SEM, TEM and AFM.

Unit – I Spectroscopic Methods - Visible Spectroscopy : 15 Periods

1.1 **Basic Concepts in Spectroscopy** : Definition, Electromagnetic Radiation-introduction, Properties of electromagnetic radiation : Wave properties –Wavelength, Frequency, Wave number, Velocity, Relation between frequency, velocity and wavenumber. Particle properties-Relation between wavelength and particle properties of electromagnetic radiation. Electromagnetic spectrum. Interaction of electromagnetic radiation with matter-process of emission, absorption and fluorescence of radiation.

Visible spectrophotometry and colorimetry–Difference between photometer, spectrophotometer and colorimeter. Theory of visible spectrophotometry and colorimety, Lambert Beer's law, nature of molar absorptivity and absorbance, deviations from Beer's law. Instrumentation of spectrophotometer: radiation sources, filters and monochromators, slits, cells and detection of radiation. Direct reading double beam recording spectrophotometer- schematic diagram and working, Difference between Colorimeter & spectrophotometer.

1.2 Applications: Quantitative analysis-calibration curve showing relationship between absorbance and concentration.

Unit –II Spectroscopic Methods (AAS & FES) **18 Periods**

2.1 Atomic Absorption Spectroscopy (AAS) :

Introduction, principle, Instrumentation : Radiation source-Hollow cathode lamp, chopper, flame atomizer, nebulisations of liquid sample, monochromators, detectors, amplifier and readout system; schematic diagram and working of single beam atomic absorption spectrophotometer, interferences, typical analysis, applications.

2.2 **Flame Emission Spectroscopy (FES)** :

Introduction : Difference between Original flame photometry and the present flame emission methods. Limitations of flame photometry. General principle of flame photometry, Instrumentation : burners, mirrors, slits, monochromators, filters and detectors, schematic diagram and working of first type- simple modified flame spectrophotometer and applications of flame photometry.

Unit – III Electron Microscopy : **07 Periods**

3.1 SEM & its application, Transmission Electron Microscope (TEM): Instrumentation, General Design, Resolution, Electron Sources, TEM grids, electron lenses, Applications.

Unit – IV Atomic Force Microscope (AFM) : **05 Periods**

4.1 Introduction, Instrumentation and Applications.

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Faculty of Science
B.Sc. II (Second) Year; Semester - III
Analytical Chemistry
"Analytical Chemistry Laboratory Course – III"
Paper Code – U-ANC-357
(W.e.f.2018-19)

Periods: 45/semester **Marks: 50**
03 per week **Credits: 02**

Learning Objective :
To familiarize the students with analysis of organic compounds, ores, metals, & alloys.

Course Outcome:
Students are able to analyse organic compounds such as ores, metals and alloys.

Note : Out of 15 experiments, at least 08 experiments should be completed.

1) Estimation of Iron in haematite ore volumetrically.
2) Estimation of Manganese in Pyrolusite ore.
3) Estimation of calcium in Lime stone volumetrically.
4) Determination of percentage purity of aluminum metal.
5) Determination of percentage purity of copper metal.
6) Determination of Nickel in stainless steel by gravimetric method.
7) Determination of percentage purity of silver metal.
8) Determination of Copper in Brass.
9) Determination of Nickel in German silver.
10) Estimation of sulphur in the organic compound by semi-micro method.
11) Estimation of phenolic hydroxy group in the organic compound.
12) Estimation of ester group in the organic compound.
13) Determination of Density of Cu/Al/Zn/Ag/Ni metal powder using density bottle.
14) Determination of halogen in the organic compound.
15) Estimation of aluminium in bauxite gravimetrically.

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Faculty of Science
B.Sc. II (Second) Year; Semester - III
Analytical Chemistry
"Analytical Chemistry Laboratory Course – IV"
Paper Code – U-ANC-358
(W.e.f. 2018-19)

Periods: 45/semester **Marks: 50**
03 per week **Credits: 02**

Learning Objective :
To familiarize the students with various instrumental analysis techniques.

Course Outcome:
Students can handle the instruments independently for requisite analysis.

Note : Out of 15 experiments, at least 8 experiments should be completed.

1) Analysis of permanganate and dichromate mixture.
2) Determination of pKa value of acid base indicator.
3) Determination of molar extinction coefficient of potassium permanganate Potassium dichromate.
4) Determination of stability constant of iron-orthophenanthroline complex by mole-ratio method calorimetrically.
5) Determination of formula of ferric sulpho-salicylic acid complex colorimetrically by Job's method.
6) Photometric titration of copper by EDTA.
7) Colorimetric estimation of Iron by Ortho Phenanthroline.
8) Determination of fluoride in a given solution / tooth paste by Zirconyl-Alizarin red method colorimetrically.
9) Colorimetric estimation of titanium in the given solution by hydrogen peroxide.
10) Determination of solubility and solubility product of sparingly soluble salt by conductance measurement.
11) Assay of boric acid by conductometry.
12) Estimation of the amount of hydrochloric acid and oxalic acid in the given mixture by

conductometry.

13) Determination of amount of vitamin B-12 in given sample by fluorometry.
14) Determination of calcium in dolomite by flame photometer.
15) Estimation of Na/ K by flame photometer in a solution/ sample by flame photometer.

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
Choice Based Credit System (CBCS) Course Structure
B.Sc. Second Year (Semester-III)
Analytical Chemistry

Credit:02 **Marks:50**

Skill Enhancement Course-I (SECAC- I)

Glass, Pharmaceutical and Forensic Analysis

Learning Objective:

1. Students will become familiar with manufacturing and glass analysis .

2.Students will understand concept underlying pharma and forensic analysis.

Course Outcome:

1. Students acquired knowledge regarding manufacturing of glass, pharma and forensic analysis.

Unit I: Glass Analysis

periods

A) Glass, Glassy State and its Properties, Classification (silicate and non silicate glasses)
B) Raw Materials, Manufacturing and processing of Glass
C) Composition and properties of following types of glasses:- sodalime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate glass, coloured glass, Photosensitive glass, Analysis of Soda lime & Lead glass.

Unit II: Phramaceutical Analysis **periods**

A) Production and Analysis of i) Ethyl Alcohol and Citric acid
ii) Antibiotics: Penicillin, cephalosporin, Chloromycetin and Steprtomycetin

Unit III: Forensic Analysis **periods**

A) Determination of alcohol in body fluids: Legal background, Sampling and sample preservation, analysis–GC, IR, enzymatic and other methods.

B) Fingerprint analysis: Latent fingerprints; Optical, Physical, Fingerprints in blood, Fingerprint detection sequences.

Skill Enhancement Laboratory Course-I (SELAC- I)

Learning Objective:

To know the lab methods like flurimetry ,colorimetry,and titrimetric methods.

Course Outcome:

Students will handle the different instruments like flurimetry ,colorimetry,and titrimetric methods

1) Determination of Vitamin B2 by Fluorimetry.
2) Estimation of Vitamin C from lemon squash by colorimetry.
3) Determination of Vitamin A by Car price method.
4) Synthesis of aspirin and its Analysis.
5) Analysis of paracetamol as per IP with respect to identification, ash and assay.
6) Determination of milk of magnesia from given antacid tablet.
7) Synthesis of benzocaine.

Reference Books:

1) 'Forensic Chemistry' by Suzanne Bell, Pearson Prentice Hall Publishers, 2006
2) Encyclopaedia of Analytical Chemistry, Volume 3, Academic Press, 1995
3) Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publication House
4) Laboratory Mannual of Organic Chemistry, R.K. Bansal, New Age International Publisher
5) Industrial Chemistry, M.G. Arora, M. Singh, Anmol Puplication Pvt. Ltd., New Delhi
6) Introduction to Ceramics, Kingery, W.D., Bowen H.K. and Uhlmann, D.R., Wiley Publisher, New Delhi
7) Medicinal & Pharmaceutical Chemistry, Hakishan V.K. Kapoor, Vallabh Prakashan, Pitampura, New Delhi

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Faculty of Science
B.Sc. II (Second) Year; Semester - IV (w.e.f.2018-19)
Analytical Chemistry; Paper - VII
"Analysis of Industrial Products and Quality Concepts"
Paper Code – U-ANC-455

Periods: 45/semester **Marks: 50**
03 per week **Credits: 02**

Learning Objective :

1.Familiarise the students with industrial product analysis and clear the concept QA & QC
2. Study the analysis of oils & fats, cement, fartilisers and pesticides

Course Outcome:

1.Students get acquainted with industrial product analysis and QA and QC.
2.They can analyze oils, fats, cement, fertilizers and pesticides

Unit – I Principles and Methods of Analysis of Saponifiable Oils and Fats : 13 Periods

1.1 Definition, Classification, Nomenclature & Fatty acid composition of oils and fats. Analysis by physical and chemical methods- Density, Specific gravity, colour, smoke point, acid value, peroxide value, iodine value, Saponification value and shelf stability value. Determination and significance of these aspects in quality control.

Unit – II Analysis of Cement : 10 Periods

2.1 Definition, types of cements, raw materials, manufacturing processes in brief. Composition and analysis of Portland cement.

Unit – III Analysis of Fertilisers and Pesticides: 12 Periods

3.1 Fertilisers: Definition, Classification, Characteristics of a good fertiliser. Analysis of Nitrogenous, Phosphatic and Potash fertilisers.

3.2 Pesticides: Definition, Classification, Characteristics of a good pesticide. Analysis of DDT and Malathion .

Unit – IV Introduction to Quality Assurance and Quality Control: 10 Periods

4.1 Quality and objectives of Analytical Chemistry.

4.2 Definitions of the terms: Quality policy, Quality Management, Quality system, Quality Control, Quality Assurance and Quality. General considerations, quality assurance and quality control spiral, Basic Steps, parameters influencing the quality spiral and tools.

4.3 Validation of the Method: Validation of instrument, Validation of analytical method.

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Faculty of Science
B.Sc. II (Second) Year; Semester - IV (w.e.f.2018-19)
Analytical Chemistry; Paper - VIII
"Radio Chemical, Thermal, Optical & Chromatographic Methods"
Paper Code – U-ANC-456

Periods: 45/semester **Marks: 50**
03 per week **Credits: 02**

Learning Objective:

1. Introduce the students to radio chemical, thermal & optical methods.
2. Study separation techniques and introduce chromatographic separation techniques.

Course Outcome:

Students got thorough knowledge regarding Radio Chemical, Thermal, Optical & Chromatographic Methods.

Unit – I Radiochemical Methods : **09 Periods**

1.1 Introduction to nuclear radiations ,detection and measurement of nuclear radiations by Gieger Muller(G.M.)Counter and scintillation counters. Tracer technique, Isotope dilution analysis and Neutron activation analysis.

Unit –II Thermal Methods of Analysis : **12 Periods**

2.1 Thermo gravimetry (TG): Theory, instrumentation and applications. Thermometric titrations.

2.2 Differential Thermal Analysis (DTA): Theory, instrumentation and applications.

Unit – III Optical Methods: **08 Periods**

3.1 Theory, Experimental techniques of measurement and application of each of the following properties in Chemical analysis: (i) Refractive Index (ii) Optical Activity.

Unit – IV Chromatographic Techniques -1 : **16 Periods**

4.1 Gas Chromatography (GC): Introduction, Types of Gas Chromatography : Gas Liquid Chromatography (GLC), Gas Solid Chromatography (GSC), Principle of Gas Solid Chromatography (GSC).

4.2 Gas liquid Chromatography (GLC): Principle, instrumentation and Applications.

4.3 High Performance Liquid Chromatography (HPLC): Introduction, Principle, Instrumentation, Solvent Delivery System, pumping systems, sample injection systems, columns, Detectors, Recorder, Mobile phases, column efficiency and Applications.

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Faculty of Science
B.Sc. II (Second) Year; Semester – IV (w.e.f.2018-19)
"Analytical Chemistry Laboratory Course – V"
Paper Code – U-ANC-457

Periods: 45 per semester **03 per week**
Marks: 50 **Credits : 02**

Learning Objective:
To familiarize the students with analysis of paints, oils & fats, cement, fertilizer & disinfectants.

Course Outcome:
Practical experiences regarding industrial product analysis are inculcated in the students

Note : Out of 16 experiments, at least 08 experiments should be completed.

1) Estimation of phosphorus in a phosphatic fertiliser sample.
2) Estimation of potassium ion in a potash fertiliser sample.
3) Determination of acid value of an oil sample.
4) Determination of saponification value of an oil sample.
5) Preparation and standardisation of acetic acid from the data of specific gravity and percentage by weight.
6) Determination of Iodine value of an oil sample.
7) Separation and determination of total pigment in a paint sample.
8) Determination of specific gravity of an oil sample.
9) Determination of loss on ignition of Portland cement.
10) Estimation of combined oxides of Fe and Al in a cement sample.
11) Determination of nitrogen in urea.
12) Determination of percentage of phenol in household disinfectant (e.g. black phenyl)
13) Estimation of SiO_2 in the given sample of Portland cement.
14) Estimation CaO in the given sample of Portland cement by gravimetric method.
15) Determination of total nitrogen in a fertiliser sample.
16) Determination of copper in given commercial fungicide sample.

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Faculty of Science
B.Sc. II (Second) Year; Semester - IV
Analytical Chemistry
"Analytical Chemistry Laboratory Course – VI"
Paper Code – U-ANC-458
(w.e.f. 2018-19)

Periods: 45 per semester	**03 per week**
Marks: 50	**Credits : 02**

Learning Objective:
To practice instrumental analysis involving, potentiometer, polarimeter, turbidometer, colorimeter & refractometer.

Course Outcome:
Students can handle the electrochemical, optical instruments and chromatographic techniques.

Note : Out of 12 experiments, at least 8 experiments should be completed.

1. Separation of amino acids using paper chromatography.
2. Determination of pKa values of phosphoric acid by potentiometer.
3. Estimation of chloride and iodide in the given mixture by potentiometry.
4. Determination of the concentration of an optically active compound in the given unknown solution by polarimetry.
5. Turbidimetric determination of traces of chloride/ sulphate.
6. Colorimetric estimation of proteins by biuret method.
7. Determination of refractive index of a given organic liquid by Abbe's Refrctometer. 08) Titration of phosphate mixture by potentiometry.
8. Determination of percentage purity of an optically active compound by polarimetry.
9. Estimation of boric acid by potentiometry.
10. Estimation of amino acids by colorimetry.
11. To study the variation of refractive index with composition of a mixture of CCl_4 and ethyl acetate.
12. Separation of components of a mixture by TLC.

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References for theory Papers V, VI, VII & VIII and Laboratory Courses III, IV, V & VI : (W.e.f. 2018-19)

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1. Text book of micro and semi micro qualitative inorganic analysis by A.I. Vogel.
2. Spot tests in inorganic analysis- Feigl.
3. Text book of quantitative inorganic analysis by A.I. Vogel (3rd edition).
4. Principles of Instrumental Analysis by DA Skoog, 3rd Edition.
5. Principles and methods of chemical analysis of H.F. Walton.
6. Quantitative chemical analysis by Cumming and Key.
7. Tex book of practical organic chemistry by A.I. Vogel.
8. Practical organic chemistry by Mann and Saunders.
9. Semi-micro quantitative organic analysis by R. Belcher and A.L. Godbert.
10. Elementary practical organic chemistry by A.I. Vogel.
11. Quantitative organic analysis by Sidney Siggia 2nd Edition.
12. Standard methods of chemical analysis by Welcher.
13. Fundamentals of analytical chemistry by D.A. Skoog D.M West & F.J. Holler (7th Ed.)
14. Instrumental methods of chemical analysis by Willard HH, Merritt Jr. LL, Dean JA, Settle Jr. FA.
15. Instrumental methods of chemical analysis by GW Ewing.
16. Quantitative analysis Laboratory manual by Day and Underwood.
17. Chemical separation methods by S.K. Dean.
18. Instrumental methods of analysis by S.K. Sharma.
19. Instrumental methods of analysis by Chatwal and Anand (First Edition & Reprint 2008).
20. Introduction to instrumental Analysis by R.D. Braun.
21. An introduction to Metallurgical Analysis by S.K. Jain.
22. College analytical chemistry by Baliga and Shetty.
23. Basic principles in analytical chemistry by Raghuvaran Prabhu, Prabhu and Sathe, Sheth publication.
24. Experiments in Chemistry by Dr. D.V. Jahagirdar.
25. Systematic experimental physical chemistry by Dr. Chondhekar T.K. and S.W. Rajbhoj.
26. Advanced practical inorganic chemistry by Gurdeep Raj.
27. Practical physical chemistry by J.B. Yadav.
28. Analytical chemistry by R.M. Verma.
29. Commercial methods of analysis by Foster DSnell and F.M. Biffen.
30. Methods in Modern Biophysics-Bengt Nolting, Springer International Edition,

Springer, 2010**,** (India) Private Limited, New Delhi (2004) [For Paper VI, Unit III & IV, Electron Microscopy & STEM].
31. Biophysics-G.R. Chatwal, Edited by Madhu Arora, Himalaya Publishing House, New Delhi, First Edition, 2005. [For Paper VI, Unit III & IV].
32. Elements of Analytical Chemistry-R.Gopalan, P.S. Subramanian, K.Rengrajan, Sultan Chand and Sons, New Delhi , 2007.
33.Analytical Chemistry Principles, John H.Kennedy, 2nd Edition, Saunders College Publishing, New York .
34. Analytical Chemistry-Theory and Practice UN Dash, Sultan Chand and Sons, New Delhi , 2005.
35. Instrumental Methods of Chemical Analysis-H.Kaur.
36. Quantitative Analysis-R.A Day and A.L Underwood.
37. Chromatography- Dr. Brown.
38. Analytical Chemistry by R.Kellner, J.M. Mermet, M. Otto, H.M. Widmer Wiley-VCH Verlag GmbH, D-69469, Weinheim (Federal Republic of Germany) 1998. [For Paper VII, Unit IV, Quality Assurance and Quality Control].
39. Progressive Inorganic Chemistry - Suratkar, Thatte And Pandit. .
40. Soil, Plant, Water and Fertilizer Analysis –P.K.Gupta, Second Edition, Agrobios (India) Publishers, Jodhpur – 2013 [for paper V, Unit 1 – Plant Analysis]

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Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
Choice Based Credit System (CBCS) Course Structure
B.Sc. Second Year (Semester-IV)
Analytical Chemistry

Credit:02 **Marks:50**

Skill Enhancement Course-II (SECAC- II)

Food Processing, Preservation and Adulteration

Learning Objective:

To familiarize the students with food processing, food preservation and Adulteration

Course Outcome:

Students got thorough knowledge regarding food processing, food preservation and Adulteration

Unit I- Food Processing:

1.1) Introduction, common food processing techniques : mincing, macerating, cooking, baking, boiling blanching, double steaming, frying, roasting.

1.2) Food processing an Indian prospective : Policy initiatives, Opportunities, Indian food Processing industry, Research methodology, Analysis methods.

Unit II- Food Preservation :

1.3) Basic principles of food preservation- drying, canning, pickling, smoking, packing.

1.4) Food preserving through Irradiation: Food irradiation, Radurization, Radicidation, Radappertization. Technologies: electron beam irradiation, Gamma radiation, x-ray radiation

1.5) Modern methods of food Preservation : Freeze drying, sodium benzoate , mechanism offood preservation, saccharin, saccharin and cancer.

1.6) Use of following compounds as preservatives: i) Phenylphenol ii) Benzethonium chloride iii) Calcium benzoate iv) Sodium benzoate v) Calcium tartarate vi) Salt & Sugar

Unit III Food adulteration:

1.7) Detection of common food adulterants in : Spices, grains, oils, milk and milk products , food colors, tea , coffee.

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Skill Enhancement Laboratory Course-II (SELAC- II)

Learning Objective:

To understand the common adulterants in food samples and isolation of pigments

Course Outcome:

Students will estimate common adulterants in food samples and isolation of pigments like tannin, caffeine

1) Determination of Calcium in milk powder by Patton and readers reagent
2) Estimation of common adulterants in food samples (such as adulterants in chilly, turmeric powder, etc)
3) Determination of phosphoric acid in cola beverages by pH metry
4) Determination of acid content in commercial pickle sample
5) Determination of moisture content in given food sample by karl fischer titration method
6) Isolation of tannin from tea leaves
7) Isolation of caffeine from coffee beans

Reference Books:

1) Food Preservation ---M.K.Singh (discovery publishing house Daryagang ,New delhi)

2) Food Science ----Shalini Pathak (Sonali Publications, Daryagang ,New delhi)

3) Food Processing --- M.K.Singh (discovery publishing house Daryagang ,New delhi)

4) Hand book of analysis and quality control for fruit and vegetable products : S.Ranganna II edition

5) Milk and milk products ---- S.Mahindra –APH Publishing house Daryagang ,New delhi

6) Food Microbiology -----W.C.Frazier/D.C.Westhoff –Tata mcgraw hill

7) Food Chemistry -----Shalini Saxena --Raga publication Daryagang ,New delhi

8) Rapid detection of food adulterants and contaminants ----Shyam Zha

9) Handbook of adulteration and safety --- Sumeet Malik